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THE BOSTON SUBWAY EXPLOSION.

The fatal subway explosion which occurred in Boston on March 4 last has been investigated by Mr. William Brophy, chief electrician of the Wire Department, and in his report to the Commissioner of Wires, gives it as his opinion that the explosion was caused by the formation of an electric arc between the wheel of the car that was demolished and the rail, or at the controller, which arc ignited the free gas. The leaks in the gas pipes, he states, could not have been caused by electrolytic action upon the pipes at this point for the reason that they were not imbedded in the earth.

The lesson to be drawn from this unfortunate accident is that the utmost care should be exercised in properly supporting gas pipes where street excavations are made. A leakage of gas is easily started and if the conditions are favorable to permit an accumulation of the escaping gas, a mere spark is sufficient to effect ignition. The usual proximity of gas pipes and electric conductors under city streets constitutes an element of danger which cannot be too closely watched.

INTERIOR CONDUITS.

The symposium of opinions regarding the relative merits of lined conduits and plain piping for interior wiring runways, which closes in this number, has shown that widely diverging views exist on the subject. While there is a considerable preponderance favorable to the use of plain pipe, the advocates of conduits having an insulating lining have made out a good case, and presented valid arguments to sustain it.

This question is one that will probably settle itself in a few years by a sort of evolutionary process. With the accumulation of experience in the operation of installations upon the two methods, the excellence of one or the other will in time be fully demonstrated. It is evident that if the wire insulation can be relied upon, and the conduit is only useful as a mechanical protection, a bare iron pipe is good enough. Even in this case, however, the additional insulation is an added security. The real question is whether or not it pays to use it, taking into consideration all the factors of safety, permanence, accessibility and first cost.

The time cannot be far distant when fixed methods of construction will supersede the use of removable conductors in tubes. The present practice, however, seems to favor the use of some form of protective tubing surrounding a system of carefully insulated wires, which can be drawn into or out of the conduits at will. So long as this continues to be the method in vogue, it is probable that both systems will have their adherents until the whole matter is settled by the introduction of a better system than either, or by the survival of the fitter of the two.

THE UTILIZATION OF WATER POWERS.

Some idea may be obtained of the difficulties sometimes to be contended with in the development of hydraulic powers for the long distance transmission of electrical energy from the article by Mr. Geo. J. Henry on "The Regla-Pachuca Power Transmission," the concluding instalment of which appears elsewhere in this issue. These difficulties have been greatly increased by the meagre transportation facilities in Mexico, and the general inaccessibility to water power sources. As pointed out by Mr. Henry, the excessive cost of fuel in the mining localities of Mexico makes it necessary to work only

such mines as yield large returns on the ores milled. Cheap power, therefore, becomes a consideration as great as a cheap method of working ores.

One of the most interesting points which Mr. Henry describes is the method adopted to overcome as effectively as possible inductance drop in the transmission line, and it would be a most valuable contribution to the subject of the long distance transmission of electrical energy to have carefully prepared tests made on the various systems of line construction now in use, for the purpose of experimentally determining the relative values of capacity and inductance per mile, and then compare such results with those which have been theoretically deduced. As far as we are aware, no such tests have been made, and the question, therefore, offers a most splendid opportunity for investigation.

THE DINGLEY TARIFF BILL.

The chairman of the Ways and Means Committee of the House of Representatives, Mr. Dingley, has introduced into the House, at an extraordinary session called by President McKinley, a new tariff measure entitled: "A bill to provide revenue for the Government and to encourage the industries of the United States." In many respects this bill is similar to the McKinley bill of a few years ago, the difference between the two being practically confined to the sugar schedule. It directly affects the electrical industries in many and important ways, and will doubtless, should it be enacted in its present form, create much confusion until the trades are adjusted to its schedules. A brief digest of the provisions of the bill affecting the electrical trades will be found on another page.

It is impossible for those not gifted with the spirit of prophecy to foretell the nature of its effect upon any specific business. As large as its direct influence upon the electrical arts may be, it is not unlikely that indirectly, through its effect upon the general business of the country, it will react still more powerfully upon these industries. It is to be sincerely hoped that this effect may be good.

If it were possible for Congress in passing this bill to give some assurance to the country that a definite tariff policy had been reached, and that the end of tinkering with import duties had come—for a period of several years, at least—the effect could not fail to be beneficial to all classes of trade. The uncertainty of tariff conditions in recent years has materially added to the depression of business, and has been a fruitful cause of trouble. No matter what their convictions as to the relative merits of Protection and Free Trade may be, business men wish to see the definite cessation of the legislative see-saw which has agitated the country for ten years.

The increase of duty on electric light carbons is to be seriously regretted. The satisfactory use of long-burning, enclosed-arc lamps for indoor lighting has been rendered possible by the excellence of certain foreign carbons, which have come to be very generally used in these lamps. The increase in the duty amounts to one-fourth of the total price they are sold at in the American market, and cannot fail to work a hardship upon both the venders and users of these goods. The enormous duty imposed upon manufactures of pyroxylene will probably have some influence upon makers of incandescent lamps using collodion filaments.

The bill is as yet in committee in the House, and has to run the gauntlet of amendments of all kinds and sorts before its passage. There is no doubt that it will pass, in some form, but there is also hope that in the Senate some of its more onerous provisions may be removed or remedied.

STREET LIGHTING BY INCANDESCENT LIGHTS.

In other columns of this issue will be found a communication from an English correspondent, in which is given the opinions of municipal authorities and electrical engineers in England, based upon their experience with the lighting of streets in small towns and unimportant streets in the larger cities with incandescent lamps. It appears that the same objections which have been apparent in American installations of this character are equally in evidence in England. Where gas has been used for street lighting the substitution of incandescent lamps has almost never been received with satisfaction by the public. The light may be sufficient for all practical purposes, but it is not materially better than gas, and does not satisfy eyes accustomed to the more brilliant illumination of the arc lamp.

Another reason for the unpopularity of the incandescent lamp for this purpose is that on the same current that will operate 160 candle-power of glow lamps, an arc of about 400 mean spherical candle-power can be burned. The cost of arc light circuits is also much less than that of incandescent circuits, especially if the latter are long and involve the use of transformers.

FOR AND AGAINST IMPROVED TRACTION FACILITIES

A strikingly anomalous condition of things obtains in this city at the present time with reference to the plans of the Metropolitan Street Railway Company, whose purpose is to substitute electric power for animal power on some of its main lines. The company is practically between two fires; one interest is exerting its strongest efforts to defeat the objects of the proposed undertaking, while another is doing its utmost to secure the improvements. In the former case the opposition, it seems, comes primarily and mainly from rival interests, and in the latter the taxpayers and business men on Eighth Avenue, below Fifty-ninth Street, demand that the railway company introduce the underground trolley system along the above-named portion of the thoroughfare, instead of carrying it down Sixth Avenue, as proposed. In both cases personal or corporate interests are the impelling influence, although they are diametrically opposite in purpose, and the peculiar state of affairs strikingly illustrates the difficulty of satisfying everybody. Without reference to the justice of the opposition from a legal, selfish or any other standpoint, the one fact remains incontrovertible—that the people of New York are sorely in need of just such street transportation facilities as the proposed improvements would afford. It is a preposterous ground for opposition to say that the Metropolitan Street Railway Company proposes to make these changes with the object of making money. We understand that this is the very purpose for which the business is carried on, and not for fun or health. The very fact that there exists a promise of returns on an investment of this character is the best of evidence that there is a popular demand for the improvements which will assure the commercial success of the undertaking. New York needs the facilities which the Metropolitan Street Railway Company proposes to provide, and every reasonable means should be afforded to enable the company to carry out its plans, provided, of course, the best interests of the people are safeguarded.

Trolley Cars on the Brooklyn Bridge.

At a recent meeting of a committee of the Bridge Trustees, offers were made by the various street railway companies proposing to use the bridge in an effort to arrive at a settlement of the question of compensation. Three classes of proposals were submitted. First, to consider the bridge as a continuation of the public streets, the companies to pay all charges of repairs and construction; second, to pay the trustees a sum for each passenger carried equal to the net receipts per passenger during 1896 on the bridge railway, and third, to collect from the passengers and turn over to the Bridge Trustees such rates of fare as they may impose.

On the Manipulation of Rontgen-Ray Apparatus.

BY GEORGE T. HANCHETT.

It has been suggested by eminent authorities that there are different kinds of Rontgen rays, which might be designated as flesh, wood or metal rays, according to their ability to penetrate various substances. The reason for this suggestion has been found in the phenomenon that not only have some substances been more easily penetrable than others (which in itself would be easy of explanation), but that these relative penetrative qualities have been found to change under slightly altered conditions of the tube or the exciting source.

It has been the writer's good fortune to experiment with a number of tubes under varying conditions, and to thereby obtain experimental results which he ventures to think will be of importance in this matter and incidentally to lead to some new methods of manipulation. This combination of experimental experience may find a sufficient audience to warrant its recital.

It is certainly a fact that a composite subject, such as the hand or a block driven full of nails of different metals will exhibit widely different grades of contrast in its component parts, although the intensity of the radiance, as judged by the brilliancy of the fluorescence of the screen, remains about the same. It is not even necessary to use different tubes to produce these effects, as the same tube will answer if the conditions are suitably varied.

This effect is often noticed on attempting to obtain a clear and well-defined image of the bones of the hand on a fluorescent screen. At first there are apparently plenty of Rontgen rays, but the image of the bones is very unsatisfactory. The hand appears to have an almost uniform but very slight opacity to the rays, and the whole appears as a grayish shadow in which the bones appear faintly outlined. The screen is brilliantly fluorescent. Suddenly there is a change, and the bones darken and stand out in brilliant contrast, while the intensity of the shadow of the flesh remains about the same. There seems to be a certain adjustment of the vibrator of the coil or a certain degree of vacuum that produces this effect; at least it is very convenient to ascribe such unexplainable phases of the experiment to like irregular influences, both difficult to estimate and entirely beyond control. Undoubtedly there is much that can justly be attributed to these causes, but there is also much that is due to other influences.

The writer has found that varying the position of the tube often produced the desired result. Momentary reversal was sometimes effective, and frequently reversing both primary and secondary terminals would cause the tube to operate properly. It was early found that in order to produce the best contrast in the fluoroscope, it was necessary to have the bombarded spot on the platinum anode as small as possible, so that the problem narrowed down to the obtaining of this bombarded spot, sometimes a very difficult thing to do.

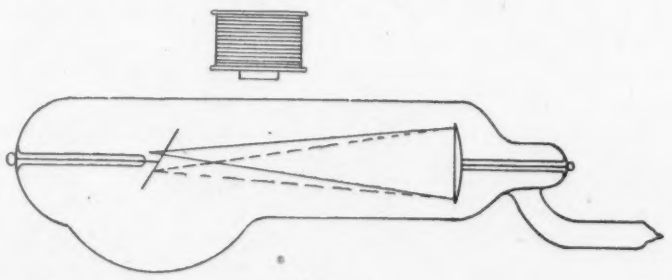


FIG. 1.

Frequently the whole anode was red-hot, and more often the hot spot was of large area and on one corner of the anode. In fact, the spot seldom occurred twice in the same place.

There was no apparent reason why this variable bombardment should occur. The focus of the cathode plate and the distance of the anode therefrom was always the same. The only conclusion was that the cathode bombardment was deflected and dispersed by outside influences. It was found that this variable effect was due to the magnetism of the core of the coil, and that even when the distance of the tube from the core was several feet the influence of the latter was still apparent. This magnetism of the core is, of course, a variable quantity and depends on the potential of the exciting source, the adjustment of the vibrator and other considerations. The obvious remedy is the removal of the tube from the proximity of the coil, and five or six feet is not too much. The influence was noted while experimenting with a coil and tube near which was another unexcited coil. On placing the hands across the secondary terminals of the latter coil, quite a perceptible shock was experienced when the other coil was operating. The effect was found to be noticeable at some distance, and served to verify the suspicions of the effect of the core magnetism on the tube.

It was found that with a strong electromagnet the bombardment could be deflected in almost any desired direction, and that in this way it was possible to completely control the position of the bombarded spot on the anode. This seems to the writer to be of some practical importance, for, by this simple means, the cathode bombardment can be deflected to a point of maximum efficiency and cause an inferior tube to become quite efficient.

It has been pointed out that it is difficult for the glassblower to adjust the anode suitably in the focus of the cathode, but by the use of the electromagnet this difficulty can be avoided. Consider the diagram, Fig. 1. This represents a tube in which the cathode focus is back of the bombarded surface under normal conditions. The bombarded spot will have a sensible diameter and will not give the sharpest possible source of Rontgen rays. By means of the electromagnet the focus of bombardment can be displaced to a point on the anode further away from the cathode, thus reducing the bombarded spot to as near a point as may be found to give the best effect. In the case of the tube shown in Fig. 2, the focus of the cathode rays falls in front of the anode and the use of a magnet will improve its action. In its normal condition the focus is a point of collision of the projected molecules, and it is evident that the bombardment must be considerably dispersed by the time it reaches the anode. If, however, the focus is deflected as shown by the dotted lines the focus of the bombardment will become a powerful source of Rontgen rays.

From the foregoing it will be seen that it is unsafe to draw any conclusions as to the existence of different kinds of Rontgen rays until the following effects have been carefully estimated and allowed for:

First, the action of stray rays, due to an enlarged and irregular source, which is incapable of producing a sharp shadow.

Second, the effect of stray rays, due to diffusion effects from objects back of the screen, *e. g.*, the experimenter's body. The possibility of this disturbing cause has been pointed out by Prof. Elihu Thomson. There is, further, the persistence of fluorescent images. It is a well-known fact that the fluorescence of a previous exposure will greatly reduce the intensity of the shadow, and with continued observation this spurious fluorescence wears off and the image comes out sharply.

These considerations at once suggest an improvement in fluoroscopes that will prove important in just the same measure that these disturbing causes prove troublesome. The first of these is to make the walls of the fluoroscope of a metal that is practically opaque to Rontgen rays, which will effectually prevent the stray rays from having any effect; further, reinforce the apparatus by a sheet of glass covering the screen next to the observer. This will also protect the screen from dust and damage. The combination would render the apparatus sensitive to rays that entered from its base only, and would not only improve its action, but might serve to clear up some of the unanswered points alluded to in this article.

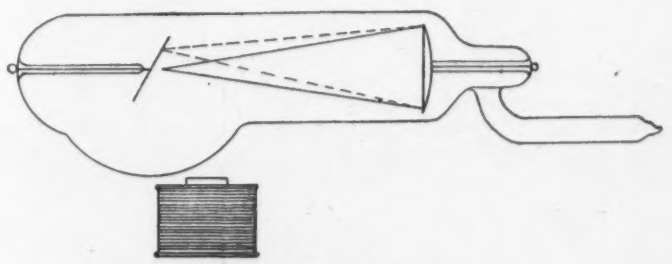


FIG. 2.

The Charms of the Telegraph.

A Bombay exchange states that a riotous mob recently wrecked the government telegraph office at Bushire, India, because they believed that it possessed charms to prevent rain. Curiously enough, there was a heavy fall of rain after the damage was done, one of the effects of which was to restore order.

The Maximum Output of Alternators.

BY DUGALD C. JACKSON.

Taking the formula, current $= \frac{\text{electromotive force}}{\text{impedance}}$, the following relations may be developed, which show the current corresponding to the maximum output of an alternator.

The impedance in an alternator armature circuit equals $\sqrt{R^2 + 4\pi^2 f^2 L^2}$, where R is the total resistance of the circuit, L is its self-inductance, and f is the frequency of the current. In ordinary conditions of operation the internal resistance of the armature is only a few per cent. of the external resistance of the load, when the alternator is operated on a dead load such as incandescent lamps, so that we may, with little error, take R to represent the external or load resistance. Then by transformation of the equation, the output, $W=C^2R$, is shown to be

$$W = C^2 R = \sqrt{C^2 E^2 - 4\pi^2 f^2 C^4 L^2}$$

and W is the maximum when $C = \frac{E}{2\sqrt{2}\pi f L} = \frac{NS}{L} A$.

In the last member of this equation, N is the magnetism entering the armature from each pole, S is the number of conductors on the armature, and A is a constant. This formula is developed in "Alternating Currents and Alternating Current Machinery," where A is shown to be approximately equal to 25×10^{-10}.

Now suppose a 50-kw alternator will show a pressure on open circuit of 2500 volts at a frequency of 125, and that its armature self inductance has the low value of 0.03 henry. When the machine is worked on a dead load without change of excitation, the output will be a maximum (neglecting the effect of armature reactions) when the current is 76 amperes, which is several times the current of normal full load. The terminal pressure of the machine will then be (again neglecting armature reactions) about 1560 volts. If the armature resistance is 2.5 ohms, the effect of armature reactions as far as they go would be decreased. The watts output for any given current decrease the current at which maximum output occurs by causing a decrease in the terminal volts. In a low-built alternator of such a low armature self-inductance as that above named, the armature reactions should be quite small where the machine is worked on a dead load. If the machine were one having a high self-inductance in the armature, as, for instance, 0.10 henry, the current at maximum load and the corresponding terminal pressure

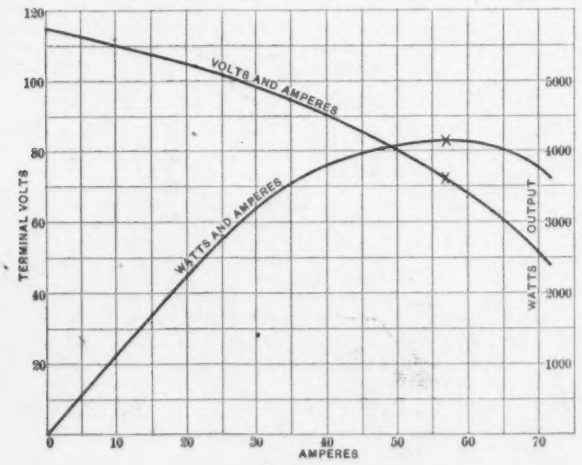


FIG. 1.

would be 23 amperes, which is little more than the current of normal full load, and about 1540 volts, neglecting the effect of armature reactions. The very considerable self-inductance in this case would cause a considerable current lag, and armature reactions would reduce the calculated figures materially if the field-exciting current of the machine remained unaltered.

The formulas which are given above are purely theoretical, but are in rational forms, and they apply with a considerable degree of accuracy to the only machine with which I have had the opportunity to experiment. This is a little machine with a rated current output of 50 amperes at 110 volts pressure. The frequency, f, is 125, and the average armature self-inductance, L, is 0.002 henry at the excitation used in the following experiments, and which was sufficient to give a pressure, E, of 115 volts at no load. By inserting these values in the formula given above it is seen that the maximum output with a fixed excitation will occur with an armature current near 52 amperes. The curves shown in the figure are the curve of terminal pressure and the curve of watts output, each in relation to the armature current. The latter curve shows that the maximum output, which was 4150 watts, actually occurred at a current of 57 amperes, and the constant, A, appears to be 29×10^{-10}. The actual terminal pressure at the maximum load is shown by the curve of pressure to be 71.5 volts, while the calculated value is 70 volts.

The measurements, therefore, seem to uphold the reasonable correctness of the simple formulas that have been given above, and which may consequently be safely used to determine the effect of a short circuit on an alternator, either in the designing or in the central station. In the latter case the value of L must be measured before the formulas can be used, but this is easily done by well-known simple methods, in which the readings of ammeter and voltmeter are all the observed data which are necessary.

Two New Primary Cells.

According to our London contemporary, *The Electrician*, Herr H. Pauling gives a description in the *Zeitschrift fur Elektrochemie* of two forms of primary cell which are in a way novel. The first consists of an ordinary battery jar with a porous cell containing two carbon electrodes, one within and one without the porous cell. In one compartment is a strong solution of sodium thiosulphate ("hyposulphite" as it is commonly termed), and in the other is chlorine water. This is equivalent to saying that the electrodes are unattacked collectors, and that the interaction of the two solutions, one of which is reducing and the other oxidising in its action, is the source of electrical energy. The E. M. F. of this cell is at first 0.64 volt; when the cell was short circuited for 50 minutes this value sunk to 0.47 volt, which was constant for five hours. The current at this voltage was 0.7 ampere. It was observed that the solution of sodium thiosulphate became turbid from the separation of sulphur, a phenomenon strongest at the electrode, but not confined thereto. It is evident from this that the reaction between the thiosulphate and the halogen does not proceed smoothly with the production of tetrathionate as in that between iodine and thiosulphate, but that decomposition of the thiosulphate occurs in some such manner as that characteristic of the action of an acid on the salt with the separation of SO_2 and S. The study of the chemistry of this cell should prove interesting.

In the second cell a well-conceived attempt is made to make use of one of the cheapest available sources of current, viz., iron. The irregularity of the solution of this metal in ordinary acid liquid and the impossibility of preventing serious local action have hitherto made its employment impracticable. In the present case the anode is iron, the cathode is carbon and the electrolyte is a solution of ferric chloride. No porous septum is necessary. Ferric chloride dissolves iron with the formation of ferrous chloride, thus—

$$Fe_2Cl_6 + Fe = 3\ FeCl_2,$$

and is regenerated by treatment with chlorine, thus—

$$2\ FeCl_2 + Cl_6 = Fe_2Cl_6.$$

The E. M. F. of this combination is 0.9 volt, so that a battery of half a dozen cells is a useful laboratory apparatus. A continuous flow of ferric chloride is maintained through a set of cells from a large vessel (holding, for example, 15 litres) provided with an arrangement for obtaining a constant head in the manner of a Marriott's bottle, and with a tubulus at the bottom for the outflow of the solution into the first cell. The cells are connected by equal-limbed syphons in the usual way. Regeneration of the ferric chloride is effected by chlorine, as stated above; but whether inside the cells or after passage through them is not stated, the description being singularly vague both in this respect and as concerns the mechanical details of the construction of the battery. The author estimates that the cost of 900 watt-hours is 25 pfennige (about six cents). This, of course, is for materials (iron and chlorine) alone.

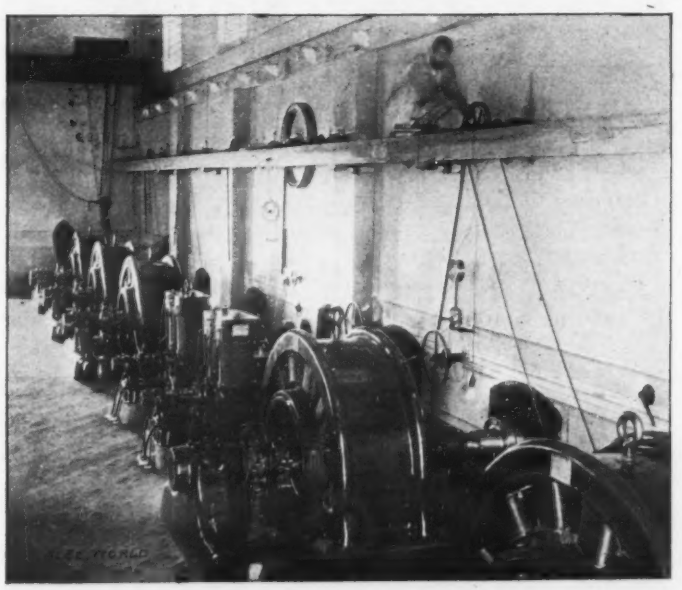
Patent Convention with Japan.

On March 9 President McKinley proclaimed the new patent convention with Japan and it is now operative. It provides for the reciprocal protection of patents, trade-marks and designs, and the article specifically relating thereto reads as follows: "The citizens or subjects of each of the high contracting parties shall enjoy in the territories of the other the same protection as native citizens or subjects in regard to patents, trade-marks and designs, upon fulfillment of the formalities prescribed by law."

The Regla-Pachuca Power Transmission.—II.

BY GEORGE J. HENRY.

THE 24-inch Pelton wheels are direct-connected to two Edison bi-polar type 25 kw 125-volt exciters running at 1300 revolutions. Either exciter is sufficient for all of the incandescent lights in the power-house, for the excitation of all five of the generator fields and also for the operation of the transformer Sturtevant blowers by motors. The exciters are each connected through an ammeter and a Weston voltmeter on a special switchboard panel to their individual switches which throw current from either one or the other to the bus-bars running along the lower part of the board and tapped by each of the generator field switches. The generators and exciters are mounted on a solid masonry foundation carried along the whole side of the building and about fifteen feet wide. Channels are left under each generator for carrying the insulated cables, which are supported by porcelain insulators set in wood frames through the remaining part of the basement to the switchboard. The switchboard consists of fourteen panels of Tennessee marble, and is mounted on an independent concrete pier. Angle iron braces are also carried through the floor and securely fastened to insulators bedded in sulphur in the wall. The illustration will make the method of connecting up clear. The panel at the extreme right contains the main switches of the exciters, and the two light bus-bars on the lower part and back of board carry the exciter current to all the fields on the next five generator panels. Each generator is, of course, provided with a main three-phase switch to the central supply bus-bars, which switches are not thrown until the synchronism between the machines is obtained. These three-phase bus-bars extend back of the centre line-panel and behind the seven transformer panels. The primary of each transformer is connected by its switch across two legs of the three-phase circuit. Thus, two of the 200-kw 60-cycle air-blast transformers are in parallel across each leg, making six transformers to carry the entire load of 1200 kilowatts. The center transformer panel carries three field switches, each representing one of the mesh connections across the three bus-bars. In this way it can be thrown in, to take the place of any one of the others that may become disabled. The secondaries of the transformers at 10,000 volts are also connected, two

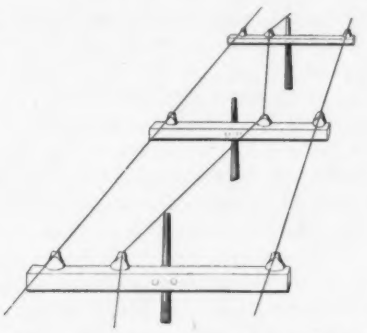


INTERIOR OF POWER HOUSE, SHOWING GENERATORS AND EXCITERS AND GOVERNOR SPEED SHAFT.

in parallel, between each leg of the line bus-bars, which in turn are distributed through the three-snap switches and through the three-leg ammeters on the centre line-panel to the line.

The method of starting up and operating the plant is briefly as follows:

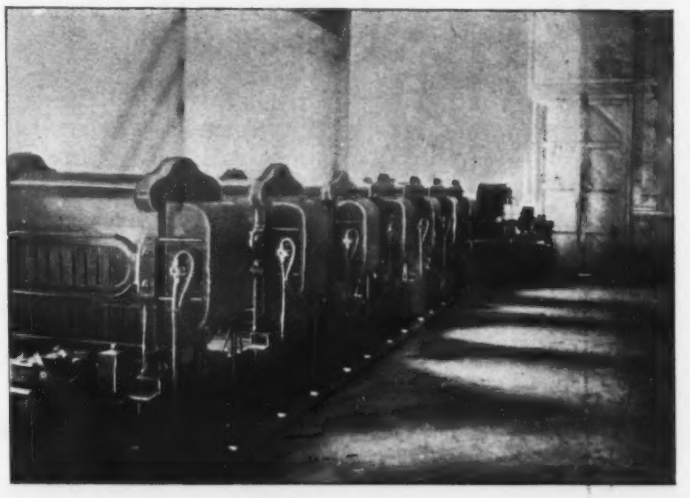
The by-pass in the 30-inch main valve between pipe line and receiver is opened, all the receiver outlets being closed. The receiver is in this way brought up to full pressure, which is indicated by the pressure gauge in power house, and the main 30-inch valve is then easily opened by one man. The station attendant, after satisfying himself that all is under full pressure, and all the ring-oiling boxes properly filled, opens the gate controlling the exciter wheel, until the exciter is brought up to the proper voltage with the four-generator fields magnetized. One of the gates controlling a generator wheel is now opened full, care being taken that the deflecting nozzle is in such position that the water will not strike any of the buckets (*i. e.*, stream entirely deflected), and the clutch connecting the governor to the nozzle being, of course, thrown out. The line switches are then closed, and also the 10,000-volt transformer switches. The first generator wheel is now started and brought up to speed by the hand lever on the governor rockshaft. On the generator attaining the proper voltage the independent Pelton wheel that drives the constant speed side of the governor is started up and brought to the correct speed, which is readily found by watching the intermediate mitre gear crosshead of the Pelton governor, this becomes stationary when the speeds are



METHOD OF RUNNING LINE WIRES.

uniform. The governor clutch is now thrown in, then the main generator three-leg switch, thus throwing the voltage on the line, which may be immediately tapped for 300 kilowatts, the full capacity of the generator.

To throw the remaining generators in parallel, the gates are opened and, one at a time, the generators brought into synchronism by the hand lever connecting with the deflecting nozzle through the governor. The synchronizing lamp on the generator panel and that of the generator, being synchronized, are used as indicators. As the machines approach synchronism, the lights grow alternately bright and dim, with less and less rapidity, until they both go out and remain so for several seconds. It is during this dark period that the generator switch must be thrown in. The machines will



TRANSFORMERS.

then immediately fall into step and divide the load equally. As soon as the generators are running together the mitre gear on the crosshead of each governor will be stationary and the clutches of the governors are thrown in.

Of course, when more than two generators, *i. e.*, 600 kilowatts, are on the line, the remaining three transformers are to be thrown in, parallel with the first three transformers, one on each leg of the circuit.

The line leaves the top of the middle panel, and through three choke coils (one on each leg) of 250 feet of insulated No. 00 wire, wound in a coil about 15 inches in diameter. This is to choke back the lightning from the switchboard and transformers, over the lightning arrester, which consists of an air gap on each leg, made up of 32 spheres of non-arcing metal, each about one inch in diame-

ter, placed in a row, and separated from each other by about 1-32d of an inch, each row being secured by machine screws to an independent marble base. To the top sphere of each of the three rows is connected one leg of the line, while inserted between the last sphere and a heavy ground connection is a non-inductive carbon resistance of about twelve ohms. This carbon resistance is for the purpose of choking back the line current that would tend to follow to ground in the wake of any lightning discharge. At several other points along the line, where lightning has proved most destructive to insulators, similar arresters have been placed, as well as at the distributing points.

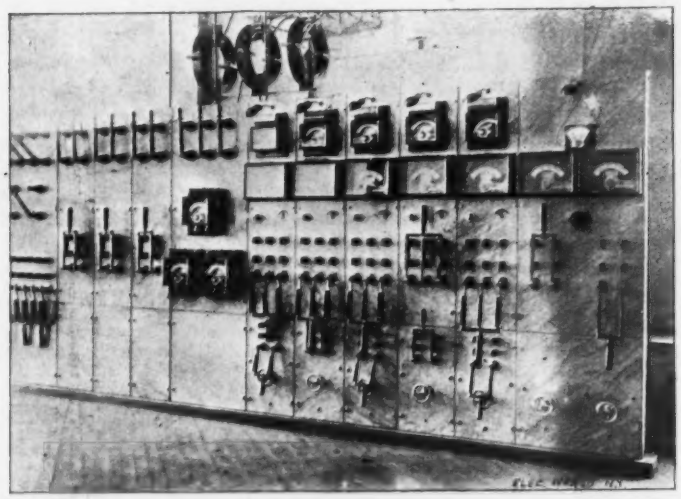
The pole line is sixteen and one-half miles long from the generating station to the main distributing station, located in Pachuca. After emerging from the ravine it crosses a plateau for about one-half the distance, the remainder being through a rugged mountain pass. The line consists of three No. 00 wires strung on double petticoat porcelain insulators on wood pins in wood cross-arms, which, in turn, are secured to the iron poles by one-half inch U-bolts. The cross-arms are bored to carry four pins, and the two outside holes are occupied by two legs of the line, while the third line alternates between, approaching first one leg and then the other; *i. e.*, it crosses the centre between each pole and the next in advance. The illustration shows this clearly. The poles are 25 feet long, and are all set, four feet deep, in masonry foundations.

At a distance of about fourteen and one-half miles from the power-house, at Real del Monte, at 10,000 feet elevation, the line is tapped and a distributing station located. One 100-kw airblast transformer is placed across each leg of the circuit, transforming the line voltage down to 1100, at which it is conveyed down the shaft of "La Difficultad" mine. This mine shaft has, for the past 20 years, been used only to drain the mines in the vicinity. On the 1800-foot level are located four 75-hp induction motors, driving two high-pressure double-acting Knowles horizontal triplex pumps, through suitable gearing. The pumps discharge the water into a drainage tunnel at the 1500-foot level. It is a fact worthy of notice that these two comparatively small pumps replace an old Cornish engine of German make, whose original cost to the mining company was more than the total cost of the power-transmission plant herein described. This old Cornish pump was driven by steam power, generated from coal at the high cost previously mentioned. In making a comparison we should also notice that this old machine was very inefficient when compared with the present motor-driven pumping plant.

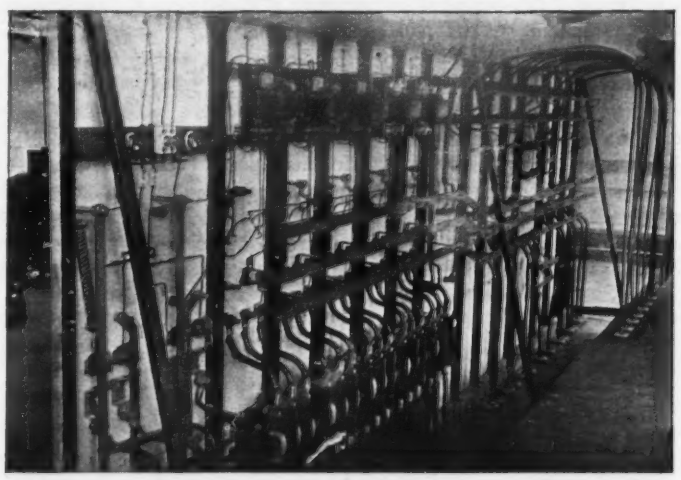
The main distributing station is located at Pachuca, a mining town of some 80,000 inhabitants, situated 16.5 miles from the generating station. A number of reduction haciendas are operated at this point, and it is the intention to supply all of these with electric power. Here three-quarters of all the ore mined in the rich Pachuca district undergoes the primitive old reduction processes which nevertheless extract a very high percentage of the precious metal contained in the ores.

The step-down transformers and distribution switchboard in Pachuca are similar in type and finish to those at the generating station. The 10,000-volt line wire comes in on the central panel, and, after passing through the fuses, which are long, fusible wires encased in porcelain tubes plugged at the ends, enters on the bus-bars connecting one side of the transformer primaries. These switches are single pole, six in number, and each pair connect the transformer switches across one leg of the 10,000-volt circuit. The transformer primary switches are also of the high voltage single-pole type, and connect the transformers, two in parallel, across each leg of the circuit. These transformers are of the 90-kw, 60-cycle airblast type, and their 1100-volt secondaries are led directly through other porcelain-encased fuses, similar in construction to those above described, and to three bus-bars running across the back and centre of the switchboard, which bus-bars in turn are tapped by the eight three-phase service switches, connecting directly with the independent service lines running to consumers' premises. T.-H switchboard meters in each circuit provide means of measuring the current sold. A three-phase General Electric fuse is placed on each of these lines, thus preventing the interference of one consumer with another.

In the Pachuca distributing station is also located a single panel switchboard on which a shunt line is tapped from the 10,000-volt main, and carried through three porcelain tube fuses, three single-pole lever snap switches, T-H meters, and out on a line for a distance of about five miles to the San Rafael mine, which will be described later. An auxiliary switch on the 1100-volt bus-bars connects three groups of two each 1100-volt transformers in parallel with 125-volt T-H oil transformers used for the incandescent lights around the station and for power to drive the motor fans supplying the airblast for the main line transformers.



Front of Switchboard.



Back of Switchboard.

Of the consumers using the current from this plant a few of the most important only will be described.

Perhaps the most interesting of all is the Hacienda of Guadalupe at a distance of about a mile from the distributing station, and is one of the oldest as well as the largest in the Pachuca district. Here are located three 50-hp induction motors, all of which drive by belting a horizontal shaft which, through suitable gearing, drives a series of Chile mills, where the ore is ground to a very fine powder, and at times also a Blake crusher. This mud is afterwards mixed with the proper chemicals, copper sulphate salt, mercury, etc., in the proper proportions previously determined by assay, and spread out in great stone patios from ten to twelve inches deep and 50 to 100 feet square. And here I will digress for a moment to speak of one of the most primitive customs of the country. Into these mudpiles are now driven from ten to twenty-five horses hitched together, an hour in and an hour out, for from eight to twelve hours a day they are lashed around and around, tramping the ore until it is thoroughly amalgamated, usually taking from ten to twenty-five days, according to the season of the year and quality of ore, etc. Considering that the best of these horses live but a few weeks, on account of the corrosive action of the chemicals in the mud, one may be sure that they are made to cover the greatest amount of mileage possible in their short span of life. There is but one brief consolation for these poor animals, and that is that they are driven into great pools after their day's work and thoroughly washed off, to save the products of amalgamation. An extra switchboard panel is also provided at this hacienda for a 10-hp rotary transformer, delivering direct current

at 110 volts, used for arc and incandescent lighting and several small fan motors.

The Hacienda of La Union is also situated at about a mile from mills driven by two motors, one of 100 horse-power and the other of 50 horse-power, a large battery of concentrators and some auxiliary machinery are supplied by a 150-hp motor.

In addition to the consumers in the town of Pachuca, the San Rafael mine above-mentioned, distant about five miles further by the line, takes about 150 kilowatts at 10,000 volts from the main line, through the distributing station switches and metres, and has three 40-kw airblast transformers supplying at 1100 volts at various levels of the mine shaft three induction motors driving specially constructed Knowles duplex mine sinking pumps, a bank of 1100 125-volt T-H oil transformers similar to those in the Pachuca distributing station, supply incandescent lights and also fan motors for the transformers.

At the Bartolomeo de Medina Hacienda, named after the patron saint of the Spanish-American mining industry, are two 50-hp induction motors, driving Chile mills.

This entire transmission plant has been in operation for several months, not only demonstrating beyond a doubt that such a scheme is a perfectly feasible one, and also that a vast saving is effected in many industries by adapting the most modern improved machinery for power transmission, but that such a plant may indeed prove a very valuable financial investment, yielding large returns with small operating expenses and a very low depreciation. It is not to be inferred that the writer advocates a transmission plant in all cases where water power may be found available, for, indeed, each particular proposition is one requiring much thought and study by competent engineers before a large expenditure should receive serious consideration. There are so many important points to be investigated besides the original cost of development and value of power in the proposed locality as well as innumerable items in connection with these two main elements that fixed rules cannot be applied and only competent authority can say whether or no the proposition will prove a valuable one to develop.

In view of the fact, however, that the Niagara power plant has been favorably reported on by many of the world's best engineers, one may certainly feel safe in making the general statement that, in nearly every instance where any market for power exists that at present is using transported fuel, it will be found advantageous to develop a scheme, employing a high head water power, made available by electric transmission when the distance is one within fifty or sixty miles, and in many instances over even greater distances. Within reasonable limits, say up to 2000-feet head, it is to be observed that the cost of developing a power scheme per horse-power will diminish, other things being equal, for the reasons that less water is required, permitting first, a canal of less capacity; second, smaller pipe lines, for as the diameter of the pipe decreases, the strength for a given thickness increases; the greater length will, however, sometimes compensate for this; third, reduction of weight in water wheels, and fourth, less weight throughout the electric apparatus as a result of the probable increased speed. The voltage that may be employed depends somewhat on the atmospheric conditions in the locality, but 10,000 volts is no longer an experiment, and the writer has recently seen a plant operating with entire success at 30,000 volts. The plant under construction at Ogden, Utah, is to employ a line voltage of 25,000. This shows that we are fast approaching that point where the line loss will become negligible over wires of sufficient mechanical strength to support their own weight. Certainly we are justified, after a most conservative view of the power transmission subject, in anticipating a great future fraught with innumerable advantages to civilization.

Meeting of the Texas Gas and Electric Light Association.

The third annual meeting of the Texas Gas and Electric Light Association will be held at San Antonio, Texas, on Monday, Tuesday and Wednesday, the 19th, 20th and 21st of April, 1897. The following papers will be read: "The Commercial Efficiency of the Incandescent Electric Light," by H. L. Monroe; "The Means of Largely Increasing the Summer Send-Out of a Gas Works," by J. C. Lord; "The Storage Battery as an Adjunct to Small Electric Light Plants," by W. L. Hall; "A Few of the Many Details of Management," by A. E. Judge; "Operating Expenses of Electric Light Plants," by J. D. Oliger; "Electrolytic Deterioration of Water and Gas Mains," by W. A. Fraser. An effort will be made to have an exhibit of gas and electrical appliances.

Street Lighting in England by Incandescent Lamps.

The employment of incandescent lamps for street lighting purposes is a subject which many electrical engineers, both in the States and in Europe, have gravely considered for some time past, and have discussed both in the technical journals and before the scientific institutions. There are very few places where actual practice has shown this system of street lighting to possess very fascinating features or to give satisfactory results. Arc lighting for several reasons—and particularly on account of its great running cost—is considered unsuitable for narrow city thoroughfares, and is unnecessary for private and unimportant roadways in villages, country towns and so forth. To bring the incandescent system in its use for street lighting to a state of efficiency and economical working is a problem which the central station man and the borough electrical engineer would be very pleased to solve.

In view of the importance of the question, it will be interesting to American electrical men to hear a few facts and opinions from the other side of the Atlantic, on the advantages and disadvantages of the system.

The notes which have been collected specially for THE ELECTRICAL WORLD by an English contributor embody opinions from experts and practical men in England, well qualified to speak upon the subject.

For several years Weybridge, a small district not far from London, was lighted by incandescent lamps, current being distributed by means of overhead wires, but when it is stated that that system is no longer employed there, an idea may be gathered as to the success with which it was employed.

At Kingswood, near Bristol, a similar street system has also been in operation for some years, but the results have given anything but unmingled satisfaction, and the local authority, though it is now negotiating with the lighting company for the purchase of the undertaking, has more than once had occasion to find fault with the lighting. The negotiations have several times been deferred.

In London, the corporation has for some time been carrying out experiments through its electrical engineer and inspector, Mr. A. A. Voysey, for the purpose of ascertaining what is the best system of lighting for the side streets of the city and the narrow thoroughfares, where arc lamps would be out of place. The city's experience in street lighting has been an expensive one, for its bill for arc lighting amounts to three or four times what the cost of gas lighting formerly totalled in the principal streets. From this point of view, as well as others, the city authorities decided that elaborate experiments should be carried out so that the expense of arc lighting should not be incurred in the thoroughfares of lesser importance. In these streets incandescent lamps have been extensively tried, and the results of the trials are to form the subject of a special report shortly to be submitted by Mr. Voysey to the Commission of Sewers. Various kinds of fittings have been tried; in some places single, double or triple light brackets were fitted to the walls of buildings, whilst in others arc lamps were temporarily strung across the roadway. A great deal of trouble has been taken with the artistic design of these fittings, so that it should not afterwards be complained that they were a disfigurement to the streets. We give a sketch of one of the triple light brackets which was tried. (Fig. 1).

At Brighton, for twelve months and more, similar experiments were conducted, and these were so satisfactory that a large number of thoroughfares are now lighted on this system. Brighton was one of the first, if not the first, town to employ the system on a large scale, and Mr. Arthur Wright, the chief electrical engineer and manager there, whose efforts have made the undertaking stand out so prominently among English electric-lighting ventures for profitable operation, reports that this street-lighting part of the installation is eminently satisfactory and is saving the corporation a large sum of money every year.

At Chelmsford some of the streets are lighted by incandescents, about 240 lamps being used. Each lamp is for 110 volts, and is coupled on a parallel circuit with twelve lamps to a transformer. The greatest distance from a transformer to a lamp is 400 yards, the lamps being about 16 feet from the ground. Each lamp has a fuse. The distance between the lamps varies according to the importance of the roads—from 45 to 70 yards. Experience here has shown that 8 cp and 16 cp lamps are not of much use for street lighting unless two are fitted in each globe. It was found that, owing to the breaking of filaments, the most careful and regular

inspection would not obviate failures. The cost per annum for the incandescent lighting works out at about 46s. 10d. per lamp.

Whitehaven.—Mr. J. S. Brodie, the borough engineer and surveyor, says: "We have here about twelve and a quarter miles of streets and roads lighted by 490 lamps, and about three miles of piers and quays at the harbor lighted by 123 lamps. The lamps vary in candle-power from 8 to 100, according to the requirements of each locality. The current is continuous at 230 volts at the station, and the lamps are arranged two in series, 115 volts at and near the station, reducing to 90 volts pressure at a distance of about one mile. No fuses or cut-outs are used, except at the station, where each of the five circuits has double-pole fuses. The lighting is quite satisfactory financially, the cost being about 10 per cent. less than the corresponding light by gas. Also the lighting has been satisfactory, the 16 cp and 64 cp lamps taking the places of the ordinary 5 feet and 15 feet burners with 16 cp gas. It is further of very great convenience that the light can be turned off and on, as may be necessary to suit the varying conditions of daylight."

Leyton.—Here a gas-driven plant (Dowson producer gas) is running. The street lighting is partly done by means of incandescents from the ordinary lighting mains. When the mains were put down, all the old gas-lamp posts had the burners replaced by a pair of incandescent electric lamps of 13 candle-power each. Two lamps are placed on each post to render the probability of the light being entirely extinguished by the filaments giving way, very remote indeed. A cast-iron box is placed below the lantern containing two single pole fuses and a switch which is worked by a rod carried by the lamp-lighter. The two lamp-holders are carried on an insulator to prevent any dampness on the lamps or holders, causing an earth on the mains. This design was drawn up by Prof. Henry Robinson, who acted as consulting engineer. Mr. H. Collings Bishop, the resident electrical engineer, says: "I consider street lighting by incandescent lamps a success where it is intended to replace gas and *not* to increase the lighting effect. Under these conditions a central station should be able to light the streets at the same charge made by a gas company. If it is desired to greatly increase the light in the streets, my opinion is that the only way is by arc lighting."

An opinion of some weight is that of Mr. J. Wilson Swan, F. R. S., of incandescent lamp fame, who makes the following communication: "As to the advantages and disadvantages of the glow lamp for street lighting, I have nothing very new to communicate. It is, of course, a matter of common knowledge that the one very great advantage of the glow lamp over every other source of artificial light is the absence of combustion and consequent non-production of noxious air, and it is obvious that this advantage is of no account in connection with street lighting, but if, in the case of streets, no special advantage can be claimed on this account, yet there are advantages, minor ones it is true, but yet

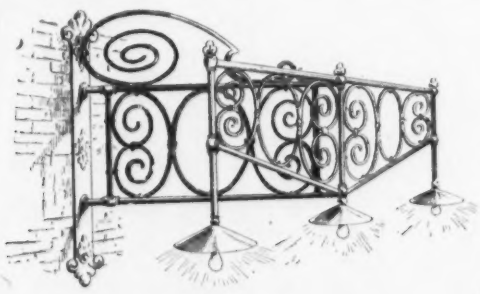


Fig. 1.

appreciable, which the glow lamp possesses, and which will in certain cases turn the scale in its favor. I refer to the simplicity and convenience with which miles of street lamps can be simultaneously lighted and extinguished and the proper measure of light suitable to the locality meted out without waste. The advantage possessed by the glow lamp in this respect would, of course, only come into consideration where the cost of equivalent light was either less or not materially greater than that produced by other means—that is to say, either by gas, or by the arc form of light, for, till now, these are the competitors with which the glow lamp has to contend. The whole question, therefore, resolves itself into one of cost. The only disadvantage of the glow lamp that I am acquainted with is its cost. Reduce its cost to a sufficiently low point, and the glow lamp will drive both of its competitors out of the street. I am not optimistic enough to be able to believe that a revolution like that is probable, but I do believe that the one disadvantage of glow lamp lighting for streets will, in the near future, be very largely reduced—will be so far reduced as to make glow lamp street lighting economical. I base this belief on the knowledge that *there is no fundamental reason* why electric current should not be produced and distributed among street lamps either by the local authority or by a company at so low a rate of cost as, all things considered, to successfully compete in most cases with any other mode of street lighting. What is possible in this direction becomes evident when one remembers that one ton of coal employed to generate electricity to light glow lamps is eight times as effective as the gas from one ton of coal employed in the usual street lamp burner, and that, as the published accounts of many companies engaged in the production of electricity go to show, the fundamental cost of a Board of Trade unit of electric energy, equal in lighting power (as developed through glow lamps at very moderate efficiency) to 100 feet of gas as used in the usual street lamp, is *less than a penny* (two cents). There is a degree of probability, amounting almost to certainty, that the cost of current production—as supplied by local authorities and public companies—will, with the more general use of electricity, become much reduced; also that the lamps will be made more efficient, partly through improved manufacture of the lamp itself and partly through optical accessories, tending to the larger utilization of the light in the required direction. Both these lines of progress converge on cheapness. How far this may go it is not safe to say, but that it may go a very long way is evident from the considerations I have mentioned, coupled with the fact that as yet, while the use of electricity is in its infancy, its cost is enormously swollen by incidental charges, which do not materially increase with increased production.

Another opinion well worth quoting is that of Mr. C. H. Wordingham, chief electrical engineer to the Manchester Corporation electricity works, which, along with Brighton and Edinburgh, are

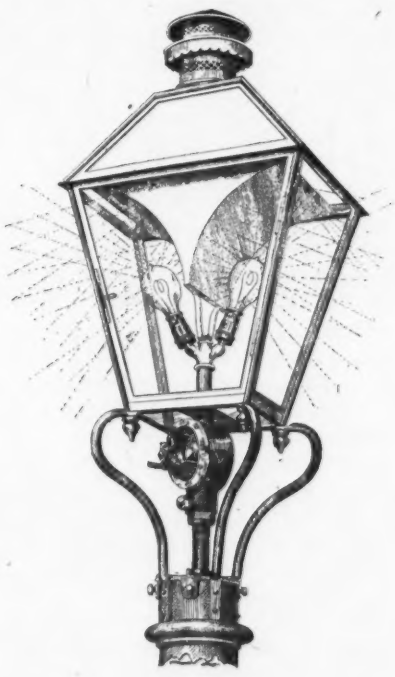


Fig. 2.

among the most successful and profitable stations in Great Britain. As a matter of fact, there is no street lighting whatever at Manchester, but there will probably be some arc lighting in the near future. "My own view," says Mr. Wordingham, "as to the lighting of streets by incandescent lamps is that they are very suitable where the streets are narrow, and especially if the houses are painted white or whitewashed. In Whitehaven there are many streets in which this is the case, and there can be no doubt that the reflection assists the lighting materially. For wide and important streets, I do not think there can be any question that arc lighting is superior to lighting by incandescent lamps, and even when it is desired to largely reduce the illumination after a certain hour at night, it is probably in most cases more satisfactory to extinguish alternate arc lamps rather than extinguish the whole of the arcs

and substitute incandescent lamps for them. In small towns, where a great expense cannot justifiably be incurred for street lighting, and where an illumination not much greater than that obtained with gas is desired, there can be no doubt that incandescent electric lamps by themselves can be used with great advantage in place of gas."

There are a number of towns and districts in the country where it is probable that incandescent electric street lighting will be tried shortly, including Bradford, where the corporation holds both the gas works and electricity works, but it is thought that that feature will prevent progress being as great as might be the case if the gas works were owned by a company. The Hampstead Vestry (London) is to try the system for side thoroughfares according to present intentions.

Fig. 2 shows a type of electric incandescent street lighting apparatus, which is very extensively in use in Brighton, and which is easily adapted to the usual types of gas-lamp posts and lanterns. The Reason Manufacturing Company of Brighton has the making of these fittings. The apparatus consists of metal base-plate with set screws for top of lamp post, adjustable screwed pipe, double-pole switch and fuse made of brass, watertight, with scaling chamber (where hygroscopic cables are used), short iron pipe carrying brass union, two lamp-holders, double-concave metal reflector enameled with white matt, with covered drop and drip edges to avoid water running down to lamp-holders. The reflectors are so arranged as to diffuse the light along the street, reflecting only those rays which would otherwise be lost either in the canopy of lantern, or, if reflected by an ordinary reflector, would only help to illuminate the base of the lamp post, which generally receives more than its share of light without a reflector.

The New Tariff.

The new tariff bill now before an extraordinary session of Congress, and having the indorsement of the present administration, has a very serious bearing upon the electrical industries. It is, of course, widely different from the Wilson tariff now in force, not only in the amount of the duties imposed, but as well in the method of charge. Many of the ad valorem duties have been replaced by specific duties, rendering it less easy for importers to undervalue their goods.

The duties on imports of various kinds relating to the electrical arts are given below:—

SCHEDULE A. CHEMICALS, OILS AND PAINTS.

Sulphuric acid, one-quarter cent per pound. Other acids, not specially provided for, 25 per cent. ad valorem.

Alkalies, distilled, expressed, essential and rendered oils, 25 per cent. ad valorem.

Bauxite, or alumina, six-tenths of one cent per pound.

Sulphate of copper, one cent per pound.

Collodion, and all compounds of pyroxylene, by whatever name known, not made up into articles, 50 cents per pound. Finished articles, including celluloid articles, 75 cents per pound and 30 per cent. ad valorem.

Linseed oil, raw, boiled or oxidized, 32 cents per gallon.

Varnishes, including Japan, 35 per cent. ad valorem; and on spirit varnishes, for the alcohol contained therein, $1.32 per gallon additional.

Bichromate and chromate of potash, three cents per pound.

Caustic potash, one cent per pound; chlorate of potash, three cents per pound.

Bichromate and chromate of soda, two cents per pound.

Hydrate of, or caustic, soda, one-half cent per pound.

SCHEDULE B. EARTHS, EARTHENWARE AND GLASSWARE.

Hydraulic cement, eight cents per 100 pounds, when in packages. In bulk, seven cents per 100 pounds. Plaster of Paris, ground or calcined, $1.50 per ton.

Kaolin, or china clay, $2.00 per ton. Asphaltum and bitumen, not otherwise specially provided for, $3 per ton.

Common stoneware and crucibles, 20 per cent. ad valorem. China, porcelain or other stone or crockery ware, undecorated in any way, 55 per cent. ad valorem. Articles, not specially designated, composed of earthen or mineral substances, not decorated in any manner, 35 per cent. ad valorem; if decorated, 45 per cent. ad valorem.

Carbons for electric lighting, 50 per cent. ad valorem. Porous pots for electric batteries, without metallic connections, 20 per cent. ad valorem.

Articles of flint, lime or other glass, moulded, pressed or blown, not specially provided for in this act, 60 per cent. ad valorem. Porcelain and opal glass, 60 per cent. ad valorem. Fusible enamel, 25 per cent. ad valorem.

Marble, in block, rough or squared only, and not dressed or made into articles, 65 cents per cubic foot.

Marble slabs, $1.10 per cubic foot, but in measurement no slab shall be computed as less than one inch thick.

Manufactures of agate, chrysolite, marble, etc., not otherwise provided for, 50 per cent. ad valorem.

Slates, in various shapes including slabs, 20 per cent. ad valorem.

SECTION C. METALS AND MANUFACTURES OF METALS.

Pig and scrap iron, $4.00 per ton. Bar iron, six-tenths of one cent per pound. Round iron in coils or rods, less than seven-sixteenths of an inch in diameter, eight-tenths of one cent per pound. All iron in forms intermediate between pig and rolled iron, one-half cent per pound. All iron in the manufacture of which charcoal is used as a fuel, $12.00 per ton.

Beams, girders, angles, channels, T-iron and all structural forms, plain or punched, six-tenths of one cent per pound.

Plate iron or steel, except saw plates, valued at one cent or less per pound, one-half cent; valued between one and two cents, six-tenths of a cent per pound; valued between two and four cents, one cent per pound; valued at over four cents per pound, 30 per cent. ad valorem.

Iron and steel forgings, one and a half cents per pound, but no forgings shall pay a less rate of duty than 35 per cent. ad valorem.

Rails, seven-twentieths of one cent per pound.

Round iron or steel wire, not smaller than No. 13 wire gauge, one and a quarter cents per pound. From Nos. 13 to 16 wire gauge, one and a half cents per pound; smaller than No. 16, two cents per pound.

Castings of malleable iron, one and a quarter cents per pound. Sheets, plates, or articles of iron, steel or other metal, glazed with vitreous glasses, 40 per cent. ad valorem.

Aluminum, in crude form, or alloys in which aluminum is the component of chief value, 10 cents per pound. Plates, sheets, rods, etc., of aluminum, 15 cents per pound. Manufactured articles in which aluminum is the component of chief value, 45 per cent. ad valorem.

German silver, unmanufactured, one cent per pound and 15 per cent. ad valorem. Copper, not manufactured, one cent per pound. Copper in sheets, rods, etc., two and a half cents per pound.

Mica, three cents per pound and 15 per cent. ad valorem.

Zinc, in blocks or pigs, one and three-quarter cents per pound; in sheets, two and a half cents per pound.

SCHEDULE D. WOOD AND MANUFACTURES OF WOOD.

Railroad ties, telephone, telegraph and other poles, of cedar or other woods, 20 per cent. ad valorem. Cabinet woods, not manufactured, 15 per cent. ad valorem. Casks and barrels, empty, 30 per cent. ad valorem.

MISCELLANEOUS ARTICLES.

Coal, bituminous and shale, seventy-five cents per ton of 28 bushels. Coal, slack or culm, thirty cents per ton. Coke, 20 per cent. ad valorem. Emery grains and manufactured emery, one cent per pound. Emery wheels and files, 25 per cent. ad valorem.

Belting leather, tanned but unfinished, 10 per cent. ad valorem.

Manufactures of asbestos, 25 per cent. ad valorem. Manufactures of india rubber, 30 per cent. ad valorem.

THE FREE LIST.

Among the articles exempt from duty are the following:

Asbestos in its natural state, not manufactured.

Asphaltum and bitumen, crude. Bauxite. Burgundy pitch. Gutta-percha, crude. India rubber, crude, scrap and refuse rubber. Shellac and lac in other forms. Chloride of lime or bleaching powder. Models of inventions and of other improvements in the arts, including patterns for machinery. Petroleum, crude or refined. Platinum, in ingots, bars, etc. Vessels such as crucibles, retorts and apparatus and parts of apparatus composed of platinum. Sodium. Wax, vegetable or mineral.

The changes are nearly all in the direction of higher and more specific duties. Among the commodities now admitted free, upon which a duty is placed by the new schedule, are sulphuric acid, salt-cake, copper sulphates, asphaltum and bitumen, antimony, copper in a crude state, poles and ties. Some of the increased duties are: Refined alumina, 0.4 to 0.6 cent a pound; manufactures of collodion, from 45 per cent. to seventy-five cents a pound; white lead, from one and a half cents to two and a half cents per pound; carbons, 20 per cent. to 50 per cent. Examples of the substitution of a specific for an ad valorem duty are: Bichromate of potash, from 25 per cent. to three cents a pound; German silver, from 15 per cent. to one cent a pound and 15 per cent.; rolled and worked brass, from 20 per cent. to two and a half cents a pound; mica, from 20 per cent. to three cents a pound and 15 per cent.

A number of duties have been left unchanged, among the most important being nickel, steel rails, structural iron, caustic soda, manufactures of asbestos, porous cups for batteries, etc.

The bill restores the McKinley duties of 1890, and in many instances go beyond them. Its effect upon the electrical industries is not easy to predict at this time.

It is probable that the bill will not pass the Senate before June, and that it will receive important amendments while in that body.

Water Power Plant at Rochester, N. Y.

The water power of the Genesee Falls in the City of Rochester has been for a long time utilized for a variety of power purposes. The Rochester Gas & Electric Light Company is now using 11,000 horse-power of this water power for the operation of electric lights in the city and its suburbs.

Electric Plant of the New York Telephone Company's new Dey Street Building.

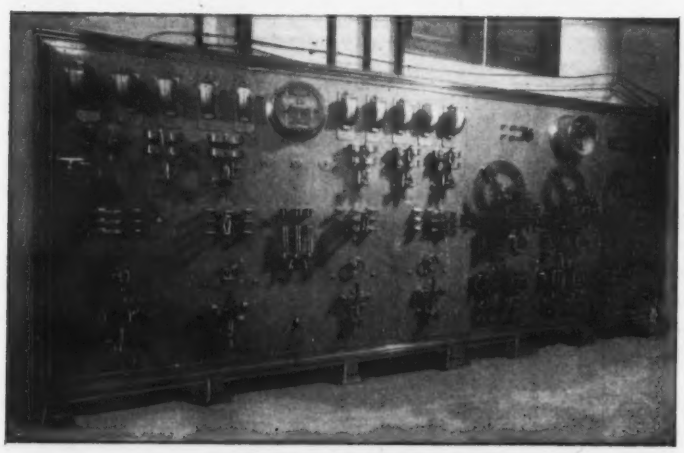
NEW YORK CITY has been the scene of one of the greatest and most extensive developments of the telephone.

Starting with a small central station at the corner of Greenwich and Liberty Streets, about a score of years ago, the Metropolitan Telephone and Telegraph Company (now known as the New York Telephone Company) extended its system until its network of wires from a dozen central stations ramify to lmost every conceivable nook and corner of Greater New York.

Some ten years ago the demands necessitated the erection of what was then a pioneer of modern office structures, on Cortlandt Street, intended as a permanent home for its main central office, and also to house the large office and engineering force of the Company. So rapid has been the growth of the business, however, that the necessity for more extensive quarters has long been felt, and has resulted in the erection of an elegant modern fireproof office structure at Nos. 17-23 Dey Street, which is practically completed, and will in the future accommodate, with the assistance of every modern contrivance, the officers, heads of departments, clerical force, engineering department, and so forth, and still leave offices to be let to outside concerns.

The new building has a frontage on Dey Street of nearly 75 feet, and extends backward to a length of 97 feet, abutting against the old Cortlandt Street building, with which it is connected on various floors. The building includes twelve floors, a mezzanine basement and sub-basement, and is built of steel framing, with arched terra cotta floors and glazed terra cotta front. As with all such structures, the mechanical and electrical equipment is really the heart of the building, and in every respect this part of the equipment may be said to be entirely first-class.

The disposition of the machinery in the sub-basement is particularly excellent. The engine, dynamo and elevator room extends across the entire front of the sub-basement, measuring nearly 75 by 25 feet. The elevators are at the extreme left, with the cable ends of the machines under the mezzanine basement floor, directly under the elevator shafts. Immediately to the rear of the engine room is the boiler and pump room, which connects with the old building. An L on the left, under the mezzanine basement floor, contains the refrigerating apparatus. One particularly noticeable feature is the unusual pitch of the engine and boiler rooms, including the height of both basement and sub-basement, and measuring



Switchboard.

nearly 20 feet. Arc lamps are used for illumination in the engine, boiler and pump rooms.

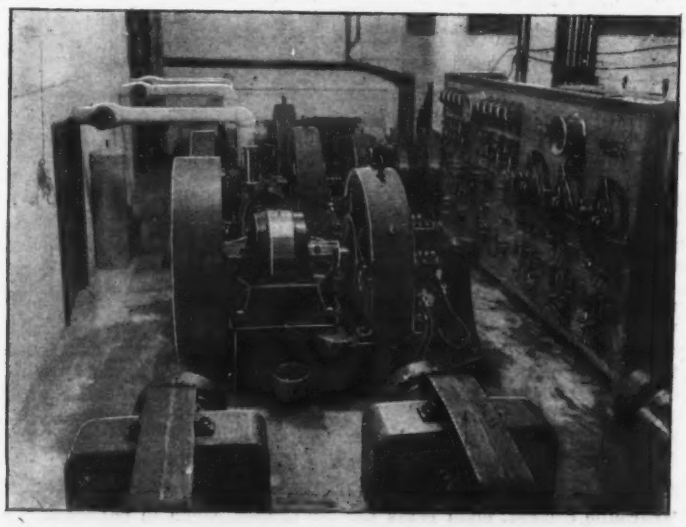
The boiler plant consists of four 120-hp Babcock & Wilcox horizontal water tube boilers, arranged in two batteries of two boilers each, giving a total heating surface of 5280 square feet, and 115 square feet of grate surface. These boilers are of the usual Babcock & Wilcox type, each boiler having a water drum 36 inches in diameter and 23 feet 3 inches long, connected to seven sections of nine 4-inch tubes 8 feet long, which are provided with a suitable mud-drum at their lower end. The boilers are set on a concrete foundation in hard-burned brick walls and bridge, and have well finished cast-iron fronts. Each boiler is fitted with pressure and water gauges, pop safety valves, blowoffs, and the other usual appliances. A 12-inch main steam receiving drum is connected to the boilers, each being separately piped to the drum and controlled by two Fairbanks globe valves in series, separated by about three feet.

Feed water is supplied to the boilers by two Worthington pumps through highly polished brass feed pipes, properly valved and extending to each boiler, and also equipped at each boiler with an injector, to be used in case of necessity. A Berryman feed water heater in the pump room receives all feed water before it passes to the boilers. Locke damper regulators are used to control the furnace draughts, as the steam pressure may require. Steam is taken from the high pressure end of the main steam drum through an 8-inch valve and Eureka separator, and each engine is separately piped from the top of a horizontal drum connected to the end of the separator, thereby insuring dry steam. All connections from this drum to the engines are very short. All live steam pipes are protected by well finished magnesia sectional coverings.

The engine and dynamo plant comprises Ball & Wood engines direct-connected to Western Electric Company's multipolar direct-current 125-volt dynamos. These are divided into four units, as follows: Three 75-kw dynamos, two of which are connected to 100-hp engines, and one, intended particularly for elevator service, connected to a 125-hp engine. These three units operate at 275 r.p.m. One small 25-kw dynamo is connected to a 60-hp engine, running at 300 r.p.m. The entire plant has an aggregate electrical output of 250-kw. Each set is mounted on a single cast sub-base, placed on a concrete foundation level with the engine room floor. The noiseless running of these generating units is to be particularly noted. A series of Y fittings from the exhaust of each engine is suitably piped to a Potter-muffler tank in the pump room, and from thence to the roof, house heating system or feed water heater, being controlled by a Keily back pressure valve.

The steam radiator house heating system is fed by eleven sets of supply and return risers, and can also be supplied with live steam from the other end of the main steam drum through a Keily reducing valve. Two Worthington pumps are provided for pumping water to the roof for general house use, and a somewhat novel feature is embodied in the supply of cooled drinking water from marble fountains located on each floor. For the latter purpose a special refrigerating plant is installed in the engine room L.

All current used for both lighting and power in the new Dey Street building, and also in the old Cortlandt Street building is to be supplied from this plant. The new building is wired for about



Engine and Dynamo Room.

1200 incandescent lamps, and the Cortlandt Street building has about 950 incandescent lamps and also several small motors. The power service of the new building is principally composed of five Sprague electric elevators.

The switchboard is a very elegant affair and is arranged to properly provide for the two classes of service, permitting any suitable manipulation of the dynamos for either lighting or power. The board proper is built of pink Tennessee marble, framed in highly polished bronze, and is set near the centre of the engine room, and about three feet from the front wall, being provided with a wire gate at each end. All generator and feeder instruments are mounted on the left-hand section of the board, while the elevator controlling appliances have the right-hand section. All connections, bus-bars and resistances are arranged on the back of the

board, and all connections and instruments are very simply and symmetrically arranged.

The generator and feeder section is provided with two sets of horizontal bus and equalizer bars, which may be connected together by a centrally located switch. The dynamo terminals come through iron armored pipe to the bottom of the board, where each dynamo circuit connects with a suitable main circuit-breaker and triple-pole, double-throw main dynamo switch, permitting any dynamo to be thrown on either the power or light bus. All the instruments are arranged in horizontal rows on the face of the board. First are the dynamo circuit-breakers at the bottom of the board, then a row of horizontally placed main double-throw, triple-pole dynamo switches; these are followed by the Carpenter enamel field rheostat handles, and above these are the lighting feeder circuit-breakers, six in number, which also act as switches. The volt and ammeters are of the Van Vleck edgewise Weston type, and are at the top of the board, being equally divided on each side of a General Electric 2000-ampere recording wattmeter, which measures the entire lighting output. There are six ammeters, three ordinary voltmeters and one differential voltmeter. An ammeter is placed in each dynamo circuit, and also in each bus service. The power bus and lighting bus voltmeters are permanently connected, and one voltmeter and also the differential galvanometer are arranged to connect to any machine. The lighting feeders are connected on one side to a total output bus-bar from the wattmeter. The power bus extends across the board to the elevator section, the entire power supply being measured by another 2000-ampere recording wattmeter, placed at the top of the elevator section.

The elevator plant of the building consists of five electric elevators, furnished by the Sprague Electric Elevator Company. Three of these are high-speed passenger machines of the screw and sliding nut type, with a car speed of 500 feet per minute and a capacity of 2500 pounds each; one sidewalk hoist of the drum type, with a chain-hoisting drum, operating the platform at 50 feet per minute, and having a capacity of 5000 pounds, and one auxiliary drum safe-hoisting machine operating at a speed of about 50 feet per minute, with a capacity of 10,000 pounds.

The passenger machines are of the standard Sprague screw type, the gearing on the machine being 8 to 1 from the sliding

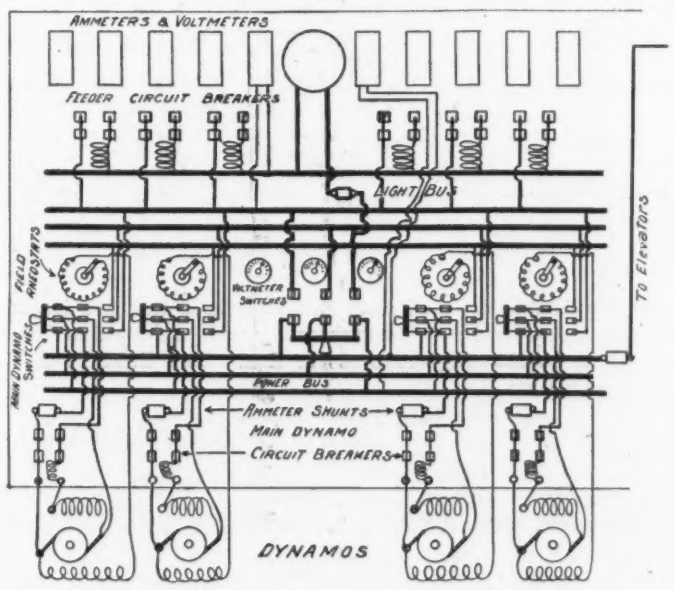


DIAGRAM OF SWITCHBOARD CONNECTIONS.

nut to the movement of the cable, which is doubled by a multiplying counter-weighting arrangement in the hoistway, giving a total transformation of 16 to 1 from the movable sheaves to the car. The screw of these machines is operated at about 275 r. p. m. by a direct-connected motor of 30-hp rating, of the four-pole compound wound type. As is well known, the motor of these elevators only takes current in hoisting, the weight of the car being used on the down trip to operating the motor as a generator through a resistance to control the speed of the car in descending. The limit of cable movement is absolutely positive. Electrical governing and safety devices are also provided at each end of the nut travel, which are operated when the limit of travel is reached, and either cut off the current or short-circuit the motor. A speed controller operates when the motor exceeds a predetermined speed limit. The car is provided with a very efficient guide gripping clutch, which operates when the car ascends or descends, uncontrolled, at an excessive speed. These elevators are operated by a pilot motor arrangement, controlled by electrical contact devices located on the car. The working of the latter operates the controlling pilot motor, which in turn operates the main motor resistance starter, and governs the various automatic switches, etc. The controlling appliances for each separate machine are mounted upon a separate vertical panel, and the three panels, placed side by side, form the elevator section of the board.

The safe hoist consists of a drum hoisting mechanism, operated by a 20-hp shunt motor through a single worm and spur gear connection. The ropes of this machine are arranged to be hooked into eye bolts on the multiplying counter-weight of the first passenger elevator, which is to be used for safe lifting, in conjunction with the hoisting ropes from the screw machine. A double-throw switch on top of the switchboard is thrown over, connecting the armatures of both the screw machine and the auxiliary safe hoisting machine in series. The two motors are then run together by a hand controller at the bottom of the hoistway, the motors being so proportioned that each takes its proper share of the load.

The sidewalk hoist is of the drum type, being operated by a 10-hp shunt motor through a worm and spur gear. The motor is operated by a controller, similar to a street car controller, by means of a hand-starting chain passing over a sheave on the controller shaft. The circuit of this machine is also controlled by a switch on the elevator section of the switchboard.

A main shaft has been provided for all wires to be used in the building for lighting, telephone or other purposes. The lighting wiring throughout the building is on the two-wire system. Rubber insulated wires, in iron armored interior conduit pipes, are used. The feeder circuits from the switchboard are run to the second, sixth and tenth floors of the new building, connecting at these points with a single vertical main, which is tapped through a junction box at each floor by two sub-mains, each extending to its respective panel box on the floor. The latter are very finely finished with marble base and copper terminal contacts, and are slate-lined and enclosed by glass doors. Outlet boxes are used at all points, and switches are almost entirely dispensed with, except in the fixtures, which will be controlled by fixture switches.

The fixtures were furnished by the Mitchell-Vance Company. Copper has been very amply placed in the various feeder and branch circuits, making the total drop about 2½ volts from the dynamo switchboard to the farthest lamp at full load.

The building has been equipped with a very complete telephone system. All main telephone cables coming from the main wire shaft are brought through iron pipes to suitable main distributing boxes located on each floor. From these main boxes iron pipe ducts are run to various lateral boxes distributed over the floor, and from there the wires are to be run to the instruments.

The building was constructed under the supervision of Mr. Cyrus L. W. Eidlitz, the well-known architect; the Western Electric Company installed the dynamos and all wiring; the Ball & Wood Company, the engines; Baker, Smith & Company and Bryme & Murphy, the piping, valves, boilers, etc., and George F. Blake Manufacturing Company, the water cooling and refrigerating system.

The Motor Mr. Depew Wants to See.

In an interview with a reporter the other day, Mr. Chauncey M. Depew, president of the New York Central Railroad, gave his views on the possibilities of making fortunes. Here is one of the questions asked him, with his reply:

"What are your opinions on the great inventions of the future?"

"The man who will make money is the one who perfects an electric motor which will enable the railway companies to move passenger and freight trains at less cost than now by the steam locomotive; which will solve the problem of street transportation, so as to supersede the overhead trolley, at less cost.

"If the flying machine can be made a success, as it will have no right of way to buy, no roadbed to keep up, no expenses for the maintenance of way, it will revolutionize everything, and make a fortune beyond the dreams of avarice for the man who makes it a success. Great fortunes are made mainly in two lines—one, inventions; the other, improvements."

The Design of Direct-Current-Machines with Reference to Sparking.*

BY J. FISCHER-HINNEN.

THE efficiency of a machine is limited, independent of the necessary mechanical and electrical qualifications, by the heating and sparking at the commutator.

While it is quite a simple matter to satisfy the first condition, up to the present, no correct formulæ have been found, which permit of determining in advance the change of brush position, or, what is the same thing in most cases, the sparking at the brushes.

In the following, an endeavor has been made to develop a theory taking into account the necessary conditions, which will permit us to design a direct-current dynamo, which will satisfy the requirement of brush-sparking. Naturally a close approximation is all that we can hope for, since, on account of the great number and

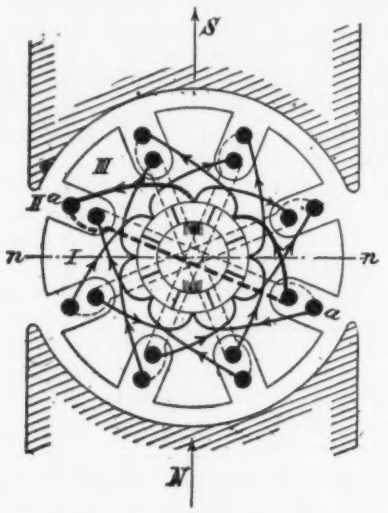


FIG. 1.

exceedingly complete phenomena, a most exact determination would result in a form which would be unsuitable for practical work.

Figures 1, 2 and 3, show three different positions of the armature.

Fig. 1—At the instant when the coil *a a* is short circuited.

Fig. 2—At the instant when the current in the coil *a a* is zero.

Fig. 3—At the instant when the current has changed its direction in the coil *a a*.

In these figures we also notice that the magnetic axis of the armature moves successively from I to II and then to III. The

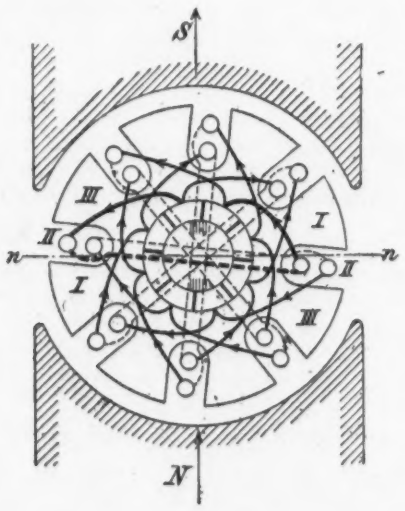


FIG. 2.

velocity with which this motion is accomplished is not entirely uniform, but it is, as we will see later, greatest at the instant when the coil is short-circuited and afterwards diminishes gradually.

The density of the lines of force in the tooth I is B_a. Let S be the cross-sectional area; the change of flux therefore, is from $+ B_a S$ to $- B_a S$. Due to this variation in flux an E. M. F. is generated in the coil, which before commutation tends to prevent the diminution of the original current, and after commutation tends to prevent its increase. That there should be no sparking when the short-circuit is broken, a counter E. M. F. must be generated. This is accomplished by shifting the brushes (in a generator, in the direction of rotation; in a motor, contrary to the direction of rotation). This counter E. M. F. assists the act of commutation, in that at the instant when the brushes leave a segment the current has practically been changed in direction and has attained its normal value.

*From *Elektrotechnische Zeitschrift.*

DERIVATION OF THE FUNDAMENTAL FORMULA.

N = Total number of conductors on the armature.

N_1 = Number of armature sections; for surface wound armatures.

$N_1 = \frac{N}{N_2}$; for toothed armatures N_1 = number of teeth.

N_2 = Number of commutator segments.

E = Difference in potential at the terminals in volts.

J = Total current in external circuit.

n = Revolutions per minute.

$2p$ = Number of poles.

$2p_1$ = Number of brushes.

r = Resistance per armature coil $\left(\frac{N}{N_2}\right)$

εE = Lost volts due to ohmic resistance; this varies in magnitude, for example from 0.02 E to 0.05 E.

$\varepsilon^1 E$ = Total lost volts in armature inclusive of the loss due to armature reaction.

D = Diameter of armature in centimeters.

l = Length of armature in centimeters.

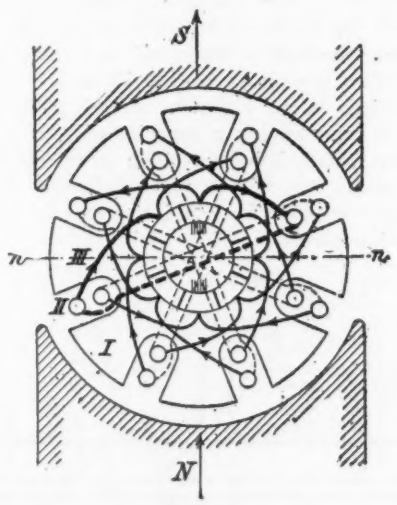


FIG. 3.

Finally let Φ be the total flux of lines of force that are included in a coil at any instant. The current strength in the coil is directly dependent on the magnitude of the flux. The E. M. F. of self-induction is then

$$e = -\frac{N}{10^8} \cdot \frac{d\Phi}{dt} = -\frac{d\,Li}{dt} \text{ volt, if the coefficient of self-induction}$$

L is expressed in henrys.

The current of self-induction is therefore:

$$i = \frac{e}{r} = \frac{1}{r} \cdot \frac{-dLi}{dt} = -\frac{L}{r} \cdot \frac{di}{dt} \qquad (A)$$

$$\text{or, } \frac{di}{i} = -\frac{r}{L} \cdot dt$$

Integrating, we have

$$log_\varepsilon\, i = -\frac{r}{L} t + a$$

$$\text{or } i = a\, \varepsilon^{-\frac{r}{L}t} \qquad (I)$$

where ε is the base of the Naperian System and a the constant of integration: $\varepsilon = 2.7182818$.

In order to determine the value of the constant a the following conditions will be found sufficient: At the instant when the coil is

short-circuited $t = o$, and $i = \frac{J}{2 p_1}$, but under this condition, from equation (I), $i = a$, therefore $a = \frac{J}{2 p_1}$

It is more convenient, for the further development of this theory, to deal with the E. M. Fs. generated than with the current strength as heretofore.

Pursuing an analysis *similar* to the last and starting with the fundamental equation (A).

$$e = -\frac{d\,Li}{dt} = -\frac{d\,L\frac{e}{r}}{dt} = -\frac{L}{r}\frac{de}{dt} \text{ or } \frac{de}{e} = -\frac{r}{L}\cdot dt \quad .$$

Integrating we have

$$\log_{\varepsilon} e = -\frac{r}{L}t + b \text{ or } e = b\cdot \varepsilon^{-\frac{r}{L}t} \qquad \text{(II)}$$

where b is the constant of integration.

To determine the value of the constant — when the coil is short-circuited, $t = o$ and $e = r\,i$, but under this condition, from equation (II) $e = b$; therefore $b = r\,i$.

But $r\,i$ represents the volts lost in the coil due to ohmic resistance; let this be E_1 and let the total E.M.F. in the coil at the time t equals E_1^1

Then $E_1^1 = E_1\ \varepsilon^{-\frac{r}{L}}$ (B)

This last equation is true as long as the brushes remain on the neutral line. If they are shifted in the direction of rotation, a second E.M.F. E_2 is generated. In a motor this second E.M.F. is additive, in a generator, subtractive.

In the following Table I will be found the values for $\varepsilon^{\frac{r}{L}t}$ and for $\log\left(\frac{\eta+1}{\eta-1}\right)$ for different values of η.

TABLE I.—Values of $\varepsilon^{\frac{r}{L}t}$ and $\frac{r}{L}t$.

η	$\varepsilon^{\frac{r}{L}t} = \left(\frac{\eta+1}{\eta-1}\right)$	$\frac{r}{L}t = \log\left(\frac{\eta+1}{\eta-1}\right)$
1.00	∞	∞
1.01	201.	7.6
1.02	101.	4.6
1.05	41.	3.7
1.10	21.	3.04
1.2	11.	2.40
1.3	7.6	2.03
1.4	6.0	1.78
1.5	5.0	1.60
1.6	4.3	1.46
1.8	3.5	1.25
2.0	3.0	1.10
2.2	2.66	0.98
2.4	2.43	0.88
2.6	2.25	0.81
2.8	2.11	0.75
3.0	2.0	0.69
3.5	1.80	0.59
4.0	1.67	0.52
4 5	1.57	0.45
5.0	1.50	0.405
6.0	1.40	0.336
7 0	1.33	0.288
8.0	1.28	0.250
9.0	1.25	0.220
10.0	1.22	0.198
12.5	1.17	0.160
15.0	1.14	0.131
17.5	1.12	0.113
20.0	1.10	0.110
25.0	1.08	0.080
30.0	1.07	0.066

The maximum current, due to this E. M. F., is E_2/r.

Since the rise of this E.M.F. is affected in the same manner by the self-induction as before, we may find in a similar manner that the effective E.M.F. generated at any time is

$$E_2^1 = E_2\left(1 - \varepsilon^{-\frac{r}{L}t}\right) \cdot \cdot \cdot \qquad \text{(C)}$$

and the current will be—

$$i = \frac{E_2^1 - E_1^1}{r} \cdot \cdot \cdot \qquad \text{(D)}$$

with reference to the above conditions when the coil is short circuited, $i = -\frac{J}{2 p_1}$; hence $E_1^1 - E_2^1 = -E_1$ . . . (E)

From the equations (B) to (E) we find that

$$\frac{r}{L}t = \log\left(\frac{E_2 + E_1}{E_2 - E_1}\right) \cdot \cdot \cdot \qquad \text{(F)}$$

Or let $\frac{E_2}{E_1} = \eta$

then $\frac{r}{L}t = \log\left(\frac{\eta+1}{\eta-1}\right) \cdot \cdot \cdot$ (G)

Determination of $\frac{r}{L}t$.

$$r = \frac{e\,E_4\,p_1^2}{N_2\,J} \cdot \cdot \cdot \qquad \text{(H)}$$

This formula is approximately correct for machines with copper brushes, in which the contact resistance is negligible; but with carbon brushes is somewhat greater, as will be shown later.

(To be continued.)

Interior Conduits.

(Concluded from page 359.)

Capt. William Brophy, Chief Electrician, Wire Department, Commissioner of Wires, Boston, Mass., writes as follows: "The insulation of conductors has attained a degree of perfection that has not been even approached by the manufacturers of interior conduit. Nothing whatever is gained by having an insulating-lined tube; the added cost for this so-called insulating lining serves to retard the introduction of electric light and power by adding an unnecessary burden of expense for the insulation of conductors for the transmission of electrical energy. I do not think a thin coating of asphaltic paint would be sufficient to prevent oxidation, the collection of moisture or abrasion of the insulation on the conductor. A thin coating of suitable enamel, however, which would prevent oxidation and permit the bending of the pipe without beaking off, would be preferable. The moisture will not accumulate in such conduits when installed in modern dwellings, office or commercial buildings. Such conduits need not and should not be installed in breweries, dye houses, paper and pulp mills. Two thicknesses of cotton braid over the insulation of the conductor is sufficient in a properly constructed metal tube, suitably enameled." Capt. Brophy does not believe in the use of lead-covered wire when used in either a bare pipe, coated pipe, or insulating-lined pipe. He does not believe it is necessary to have an insulating lining acting as a distance-piece between the iron and the insulation of the conductor. "Those who are clamoring for insulating lining, extra protective covering on the conductors, thick lining as a distance piece and other impracticable fads, seem to forget that there are miles of plain metal tubing in the form of shells covering gas pipes connected with chandeliers that contain hundreds of miles of wire, the insulation of which is not of the very best, that has given practically no trouble at all; yet, in the face of all this they keep up a constant silly twaddle about the necessity of all insulating-lined conduit, while all that is required is a properly-constructed wire that will afford mechanical protection to the conductors.

"To insist on an insulating-lined conduit in addition to a first-class insulation on the conductor is, in effect, offering a premium on refined petroleum, candles, gas of good, bad and doubtful quality, and at the same time imposing a tax on electric lights and motors. The relations between the insulation on the conductor and that of the tube should be as distant as the north and south poles are from each other; there is no need of an insulating lining in a conduit; the conduit should be coated with a substance that will not crack when the pipe is bent to a right angle and at a proper radius; that will prevent oxidation and adhere to the metal when once applied.

"The bug-bear, 'moisture within interior conduits,' should be allowed to die in peace and be decently interred."

Mr. George Zimmerman, electrical engineer and contractor, Newark, N. J., writes that a tube should have an insulating lining

so as to offer an extra and more protected insulation. He believes that the lining in the tube should be a pliable waterproof insulation, something corresponding with the softness of insulation on wire, to prevent abrasion when drawn through. He believes that no extra protective covering under these conditions is needed on the conductor. He does not approve of lead-covered wire for building-wiring, but for underground conduits only. He believes in having a thick lining acting as a distance-piece between the iron and the insulation of the conductor. This lining should be for ⅜-inch iron conduit, ⅛ of an inch thick, and heavier in proportion in larger sizes.

Mr. J. Draper Bishop, New York City, writes:

"There seems to be a popular impression that the present condition of 'Interior Conduit Wiring' is a phenomenal development of a brilliant modern invention. From my own experience I think interior conduit work is about cœval with insulated wire. I can certainly recall instances so far back as 1859 or 1860, in which it was used for 'bell wires' and telegraph wires. We were satisfied to call conduits 'wire pipes' in those days, and that is all they are at the present day.

"I am not alone in very strongly deprecating the halo of fictitious importance and specialty with which the advocates of various styles of conduits strive to endow their wares.

"If there is much more of this empty booming of these special makes of 'wire piping,' the interior conduit will shortly become a more important factor than the wire itself. As it is now even, there is a tendency to slovenly wiring too often, traceable to misplaced reliance on some supposed insulating or other virtue claimed for the conduit.

"I think I can give you my opinion more concisely in my own way than by replying seriatim to your queries.

"I am a staunch supporter of the interior conduit system for all buildings using current, although I do not hold that wires cannot be safely 'run' without it. But conduit work serves not only to carry wires and allow them to be withdrawn with comparative ease; it also protects them from liability to damage by clamps, nails, staples and also the many other weapons of the zealous and irresponsible artisan of every branch of building. In the absence of these causes, there are still two other dangers—the corrosive action of acids and salts arising from contact with damp or wet mortar and lime, and the attacks of such small deer as rats and mice. On account of these latter, 'wire pipes' of bamboo and lead pipe have been abandoned, and their place is very efficiently taken in the far East by common pipe or tube, made from sheet tin strips soldered together.

"*Insulating of Metallic Conduits.*—I can see no *raison d'etre* for it. Insulation is not insulation unless it continuously insulates, and it is impossible to uniformly insulate a tube having many joints and bends.

"If the conduit is so circumstanced as to be always dry internally, no further protection is required. If, on the contrary, its interior surface is to be continually coated with moisture, every small break in the so-called insulation is a ground. The same may be said of painting or enamelling the interior to prevent oxidation or rust. If the conduit is dry no corrosion will occur. If the contrary condition obtains, which can scarcely ever be entirely prevented under certain conditions of atmosphere and temperature in these latitudes, the remedy is to be found in proper ventilation, or the prevention will lie in providing a non-oxidizable and non-hygrometric conduit.

"As to metallic sheath or armor of any kind on a wire, I would not condemn a wire because it boasted one, but I would ruthlessly condemn as worse than useless any system of conduit requiring its wires to be protected against the injuries itself might inflict on them. Such cheap and shoddy work should be vigorously suppressed.

"The supposition or claim advanced that such armoring or sheathing on a wire assists it to bear the strain of 'pulling through' is a too dangerous one to find support with thinking men.

"A wire should never require to be 'pulled through.' There should be room enough in the conduit to allow it to be 'drawn' through without bringing more strain on it than any well-made insulation would stand with perfect impunity.

"'Hauling' and 'dragging' wires through conduits are evidences of carelessness and ignorance. I am well aware that emergencies may arise when a strong steel braid on a wire may be invaluable, but no emergencies ought to arise in well planned conduit work.

"There are two ways of wiring a building. One is to try to provide against every possible contingency, and then allow the possibility of every contingency.

"To do this, get a cheap grade of insulated wire, protect the 'insulation' from possible access of moisture by a 'waterproof' tape, which loosens when bent, surround this with a braid to support the 'insulation' beneath it; wrap some fibre around this to absorb moisture, and coat it outside with metallic sheath to protect it all against abrasion.

"As this will make a fairly stiff cable, sinuous when uncoiled, pull it through a small, weak conduit lined with some kind of insulation which will crack, chip, peel off or strip, thus providing both immediate obstruction to 'pulling in' and future destruction from accumulation of moisture by the decomposed 'insulating' matter, and you have a not uncommon example of 'how not to do it best.'

"The other method of wiring a building is to *prevent* dangerous contingencies, and so avoid all necessity of providing against them.

"To secure this end, a first-class rubber-compound insulated wire is the first and absolutely indispensable means. And the insulation should be laid on liberally, where it is required and of use, and that is round the wire, and nowhere else.

"With such a wire I would be quite content to rely implicitly on a plain smooth-bore iron or steel pipe of ample dimensions, which I would try to terminate, if possible, where it would naturally keep itself dry and ventilated, and not allow it to open out over a drain, boiler room or laundry.

"I believe the function of the conduit should be confined strictly to the mechanical protection of the insulated wire, to which alone should be left all question of safety electrically, and any attempt to blend these two functions in either member of the system is a step in the wrong direction.

"Good wires carefully drawn into roomy, dry, ventilated conduits will remain there undisturbed so long as the building does."

The Eastern Electric Cable Company, 61 Hampshire Street, Boston, Mass., writes that the article by Prof. Anthony, which appeared in The Electrical World of Feb. 13, 1897, page 225, covers the whole question of interior conduits.

Mr. Townsend Wolcott, consulting electrician, Bennett Building, New York City, writes as follows:

"I will say at the outset that I am in favor of lined conduits, although I am aware of a somewhat popular movement in the other direction. The partisans of bare iron base their arguments largely on the aphorism 'the insulation should be on the wire.' Popular opinion is often swayed by catch words having an epigrammatic ring, regardless of the soundness or unsoundness of the underlying principles, and this is a case in point. Let us apply this insulation-on-the-wire theory to other things, and the sophistry on which it rests becomes plain. Many buildings have fire escapes in the form of stairways on the outside, entirely independent of interior stairways, but it is obvious that the place for stairways is in the halls of the building, so that it would be much better to put in interior stairways equal in width to the present interior stairways plus that of the present fire escapes, and the latter could be removed and the walls of the building devoted to their legitimate use, namely, keeping out the weather. The hulls of many modern vessels are built with an inner and an outer skin, both water-tight under normal conditions and separated by considerable space. This is commonly considered an additional safeguard, but it is obvious in the light of our theory that the place for the skin is on the outside; therefore, make the outer skin twice as thick, remove the inner skin, which allows the interior of the hull to be used for storing cargo, its legitimate function, and congratulate yourself on the improved hull that you have invented.

"The elevated railways of New York and Brooklyn have an additional precaution to prevent trains from running over the trestle into the street, known as the 'guard rail.' It is obvious, however, that the place for flanges is on the wheels, and if we make flanges as deep as the guard rail to replace the present flanges, we will have no further use for the guard rails, except as fuel.

"Moreover, the insulation-on-the-wire principle, if carried to its legitimate consequences, would save lots of trouble to the constructor, as under it all insulating bushings and pole insulators can be dispensed with, provided covered wire is used. It may not save trouble to those who come after the constructor, but that is another story."

Mr. Wolcott does not believe in a thin coating of any substance on the interior of a metal pipe, nor an extra protective covering on the insulation of a wire in addition to a thin coating in the tube.

He states that lead covering is chiefly valuable because it is air-tight and water-tight. It is not a good mechanical protection, and ought not to be necessary in ordinary inside work. He does not believe that there is room enough in a pipe to allow of a distance-piece being of much value. He believes in an insulating-lined conduit, the insulation resistance of the lining being depended upon as an additional safeguard. He believes that the tube insulation should be enough to withstand the normal E. M. F. of the system without serious leakage.

Prof. W. M. Stine, Armour Institute of Technology, Chicago, Ill., writes as follows:

"There is little doubt that some form of metallic conduit system will soon become the recognized standard method of installation of electrical conductors. Plain galvanized iron or steel gas pipe seems to meet all the necessary requirements. The dangers resulting from rust and moisture are not to be greatly feared, and constitute no fire risk if the conduit is properly grounded. A coating of tin or lead on the interior decreases the danger due to oxidation to a minimum.

"The interior of the conduit should be practically continuous and smooth. To secure this, elbows and bends should be of bent pipe of the same size; the abutting ends should be finished up true and be free from burrs. Short bends should be avoided. The sections of the piping should be joined with screw couplings, packed as for a steam line. This would require extra care in fitting, but would produce a smooth and continuous draw-way. In this case there would be no question of mechanical damage to the insulation of the wire. I believe the insulation should be entirely on the wire and should be of rubber secured with a substantial braided covering. The thickness of the insulation would be governed by the same considerations as apply to lead-covered cable. I would advocate running both sides of the circuit in the same duct, whether it is a continuous current or alternating circuit.

"The reasons for employing a metallic conduit are to prevent mechanical injury to the insulation of the circuits and the more important consideration, to provide a durable draw-way, which shall permit the wires to be withdrawn and inspected as well as renewed.

"Should the insulation be placed wholly or in part on the walls of the conduit, then the principal reasons for installing the expensive conduits are defeated, for the life of the conduit would be limited by that of its insulation."

Mr. P. M. Mowrey, vice-president and general manager of the Globe Electric Construction Company, New York, writes as follows:

"We believe the insulation should be on the conductor, as it does not in any way impair the flexibility or easy handling of same, whereas, if it is placed in the tube, it entails various difficulties of a character depending upon the material used in lining the tube, in handling and installing same, and after it is installed creates trouble which practically defeats the primary object of its use.

"There is absolutely no object or advantage that we have been able to ascertain by having an insulating-lined tube. If we use an insulated wire in an insulating-lined tube, the insulation on each bears a proportionate percentage to the combined result, and if that be true, would the result not be the same in megohms of resistance if we put the entire insulation on the wire?

"We know positively from practical experience that a thin coating of hard asphaltic paint will absolutely prevent oxidation and the collection of moisture. If the tube is originally of smooth bore, as it can be obtained from any pipe manufacturing company, there is no question of abrasion of the insulation on the conductor, and if the tube is not absolutely smooth bore, the application of a thin coating of hard asphaltic paint will tone down a great majority of the small inequalities or rough projections in the tube to such an extent as to render them practically harmless.

"We think that an extra protective covering on the insulation of the wire is absolutely unnecessary and a useless expense, as the data in our possession of practical tests made by competent parties shows that the insulation resistance is the same whether the tube be lined with an insulating compound, whether it be absolutely plain or treated with a thin coating of asphaltum paint, and if the ordinary forms of first-class commercial wire be good enough under one condition, why not under the other?

"We think that the use of lead covering on the wire to be ill-advised in any form of installation, and believe that the first-class rubber-insulated wire, protected by a good, strong braid, is far superior to the best form of lead-armored wire that can be made, and, if in place of the lead we have a second protective braid made of thin, hard fibre, we believe it would be an ideal form of insulation, without any regard whatever to the kind of tube it may be installed in.

"We do not think it necessary to have a thick lining acting as a distance-piece between the iron and the insulation of the conductor. Let it be determined what amount of insulation resistance is required, and let us then place it either on the wire or in the tube. What possible advantage can be gained by dividing it up in two or three or a dozen departments?

"As the application of a coating of hard asphaltic paint to the inside of a plain tube is comparatively inexpensive and prevents the condensation of moisture and oxidation, it offers some advantages, and we should regard it as preferable to the plain tubing, but not to a great degree, as we have made some practical experiments in this direction by inserting a rubber-insulated wire with the ordinary braid on the outside in a plain iron pipe, and subjected the whole to conditions favorable to producing rust and corrosion, making frequent tests of the wire, and found that in a period of eight months the insulation of the wire had undergone no appreciable change due to oxidation and exposure to moisture, etc.

"In conclusion, we beg to say that as we are practically the pioneers in the use of an unlined tubing for electrical conduits in house wiring, we have been the recipient of numerous expressions of opinion from experts in all parts of the country, and, as the matter had a practical interest to us, we have gone into the subject quite exhaustively. We were made the object of attack by the parties most interested in continuing the use of a lined conduit, and in refutation of the arguments set forth by these people were compelled to get expressions of opinion and practical tests from engineers and scientific men standing high in their profession, and in pursuit of this object we have unearthed some practical demonstration of the correctness of our theories that the desirable form of installation is made up of smooth-bore, unlined iron, or steel conduit in conjunction with the ordinary form of first-class commercial wire.

"We have installed the entire wiring system in the Bowling Green Building in this way, with the exception that we have been compelled by the Fire Department to use wire with a lead covering, although we have pulled six No. 16 ordinary braided wires without a lead covering through 400 feet of ¾-inch tube in the building, without damage to wire and practically no abrasion of the insulation, the wire having been tested after it had been pulled through, and showing the same result as before it had been subjected to this treatment.

"As stated before, we believe the whole question to resolve itself into the question of how much insulation is desired. That fact having been determined, let us place the required amount of insulation on the wire and install same in a plain tube, or put it in the tube and install a bare wire; but from a standpoint of economy and general practicability, it will be found desirable to put the insulation on the wire instead of the tube."

Messrs. Freedman, Rennard & Co., 136 Liberty St., New York City, write that they "believe most emphatically that the insulation on the conductor is that which should be relied upon, and that the function of a tube conduit is merely to act as an armor to the insulation of the wire, and to protect it from water and moisture; but, of course, the tube should be so arranged that it will not scrape off or seriously injure the insulation of the wire when the latter is pulled in.

"We think the advantage of having an insulating lining in the tube lies in the fact that such lining presents a smooth surface to the wire, and therefore reduces the abrasion to a minimum, and if any abrasion should occur cutting through the insulation on the wire, it prevents the exposed part of the conductor from coming in contact with the conducting armor of the conduit.

"A coating of asphalt paint, or similar substance, should be amply sufficient to prevent oxidation, and to a large extent the collection of moisture, and if thick enough to produce a smooth surface, it will also prevent serious abrasion of the wire.

"We think an extra protective covering, consisting of a couple of stout braids saturated with compound similar to that used in weather-proof wire is highly desirable in addition to the coating of asphalt compound, and with it amply sufficient to protect the conductor."

They do not think it necessary to have a lead covering on the wire, neither a thick lining in the tube acting as a distance-piece between the metal and insulation of the conductor, nor do they believe

in an insulated lined conduit, the insulation resistance of the lining being depended upon as an additional safeguard.

"We think that asphalted iron or steel tubing may be sufficient in many cases if properly installed, *i. e.*, of sufficient inside diameter, butt joints and wrought iron bends to be used throughout, end of all tubes to be carefully reamed and freed from burrs; and if wire protected by additional saturated braids as noted above is used in it.

"In addition, we might add that we believe a plain, thick walled iron or steel pipe, asphalted, if properly installed, is preferable to an insulated tube, consisting of an insulating lining, with only a thin metal armor, and having a total thickness equal to that of the heavier iron or steel tube.

Mr. Elias E. Ries, 1031 Temple Court, New York City, writes:

"I have for some time past given considerable thought to this subject, and I therefore beg leave to respectfully reply to the various questions you ask, as follows:

"1. For all ordinary interior voltages, such as those now generally used for incandescent lighting and for other purposes, say up to and not exceeding 250 volts, the entire insulation should be on the conductor. An exception, however, may be made in the case of conductors supplying apparatus of high self-induction, in which a high abnormal E. M. F. is likely to be developed on suddenly opening the circuit.

"2. As a rule, there is nothing gained by having an insulating lining in an iron tube intended for low-voltage conductors. Such lining involves not only needless expense and mechanical complication, but if the tube is lined with fibrous material, is decidedly objectionable, because of the increased friction and abrasion in drawing in the conductors and the additional internal clearance and enlarged diameter of the outer tube necessitated thereby.

"3. (a) A thin coating of asphaltic paint, enamel or similar substance will, in my opinion, be amply sufficient to prevent oxidation; (b) it will *not* prevent the collection of moisture; (c) it will prevent the abrasion of the insulation on the conductor, if the coating has a smooth polished or enamelled finish. Moisture or condensation in such tubes may best be prevented by so arranging the conduits as to cause a natural draught of dry, warm air through them by using them to a certain extent as ventilators.

"4. An extra protective covering on the wire, in addition to a thin coating of asphaltic compound or enamel, in the tube will be more than sufficient. All ordinary insulation for indoor work should be of such character as to withstand abrasion to a reasonable extent. A little soapstone may be applied to the insulation on the wire before drawing, so as to reduce friction.

"5. Lead covering on the wire is, in my opinion, entirely superfluous for indoor use, either when applied in the case of bare, coated or insulated-lined tube, except in horizontal underground subways or cellar ducts that are subject to constant moisture, or by reason of their position are liable to inundation.

"6. I do not consider it necessary to have a thick lining acting as a distance-piece between the iron and the insulation of the conductor in the case of low-tension currents. For high-tension currents such a lining would be an advantage in reducing the thickness of the conductor insulation, and for preventing the likelihood of a defective spot in the conductor insulation from meeting with a similarly defective spot upon the lining of the tube. As any imperfection in the insulation developing at any given point, either of a wire or tube, is likely to extend through the whole thickness of the insulation, particularly if of a brittle character, the division of the total thickness of insulation between the conductor and the tube would be of advantage on this account, in the case of high-tension conductors, and would avoid the necessity of drawing a thickly covered conductor through the tube.

"7. While I do not advocate insulated-lined conduits for interior work, particularly for a single conductor or pair of conductors, which can be supplied with a proper insulation at low cost, yet where this form is to be used I should say that the insulation resistance of the lining can be depended upon as an additional safeguard. In all ordinary cases, however, I believe it to be desirable to rely entirely upon the conductor insulation, except in the case of ducts intended to hold a large number of wires, in which the cost of additional lining can be divided among a number of conductors, and for the reason that in such a duct there is likely to be such frequent drawing in and out of individual conductors as would abrade a light protective coating of asphalt paint or enamel.

"8. The relation between the thickness of the insulation on the conductor and that of the tube is immaterial, where the insulated-lined conduits are employed. The lining should be sufficiently thick, particularly at curves and bends, to prevent wear by abrasion.

"9. I would not ordinarily advise the use of an absolutely plain iron or steel tubing, unless the same is asphalted or enamelled to prevent corrosion. In perfectly dry locations, where the conduits are not subject to oxidation, a plain iron or steel tube having a smooth inner surface may be used, but even then it would be preferable to galvanize or otherwise treat the surface, so as to prevent attack by chemical action from the rubber or other insulating covering of the conductors that are used therein, either from normal causes or under the influence of the heat generated in the case of an excessive current flow.

"In conclusion, I might say that where plain or coated tubes are used the interior of the tube should in all cases be perfectly smooth; the entrance and exit openings should be made flaring; all edges, particularly at joints, should be chamfered on the inside and be free from burrs, and that curves and bends should be given as large a radius as practicable. The most preferable type of conduit for interior work, to my mind, is undoubtedly that formed of thin, drawn-steel tubing, either drawn seamless or made up from webs or strips of steel (the meeting of edges of which in the latter case may be electrically welded or brazed, so as to form a tight and invisible joint during the process of forming the tube), and the interior of which is perfectly smooth and polished by being drawn over a mandrel, as such tubes have the advantage of lightness, great strength, absolutely uniform diameter and thickness and smooth finish. Such tubes may be readily made in any requisite length and can be joined by plain or threaded sleeve couplings, or in any other desirable manner, and in conjunction with properly insulated wires constitute, in my estimation, probably the simplest, safest, most satisfactory and most economical means for conveying and distributing electrical currents through the interior of buildings."

An Induction Booster.

BY ALBERT G. DAVIS.

In view of the recent discussions as to the ownership of the "booster" system patents, it is interesting to note that Mr. Kelly has discovered that an ordinary induction motor, having its field coils in series with the mains, will act as a booster, or feeder regulator, on alternating circuits. It has been known for some time that the induction motor was reversible; that is to say, that if it were driven above synchronism, it would return current to the line rather than take current from it. Mr. Kelly has discovered that this action, at any particular speed above synchronism, depends upon the amount of current supplied to the field magnets for excitation.

He simply connects in series with the feeder to be regulated or compounded the field magnets of a small induction motor, and drives the motor above synchronism in any suitable way. If no current is passing on the feeder, there will be no current induced in the armature of the motor, and no action whatever. But, as soon as the current begins to flow in the feeder, it will induce current in the armature of the induction motor, which will react on the field currents to add to their voltage. At any given speed above synchronism the boosting action depends in amount on the strength of the current in the feeder, while the action is varied by varying the speed at which the motor is driven. This evidently allows a generator to be compounded or over-compounded without the use of sliding contacts, commutators or other objectionable apparatus, and also allows each feeder to be compounded separately, if desired, and all the feeders to be supplied from a single source of current.

Moving the Field Frames of Direct Connected Units.

To the Editor of The Electrical World:

Sir:—With regard to the claims of some of your correspondents, in the issue of March 13, that they were the first to originate the idea of moving the field frames of dynamos, to allow inspection of the armature, I think they must all give way to Mr. S. Z. de Ferranti, who adopted this method of removal of the field frames in the dynamos installed by him in the old Grosvenor Gallery Lighting Station, in London, in 1886. The divided field frames were arranged to slide horizontally along a planed, cast-iron bed, the motion being at right angles to the shaft, precisely as described by Mr. B. J. Arnold in the issue to which I refer. I hope that, in justice to Mr. Ferranti, who is not here to speak for himself, you will publish this letter. William H. Donner.

Scranton, Pa.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES FOREIGN AND AMERICAN JOURNALS

COMPILED FROM

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Theory of Constant Speed Direct-Current Motors. RHODES. Lond. *Elec. Rev.*, Feb. 26.—A theoretical investigation of how to compound motors so as to maintain a constant speed under all loads up to a certain limit. His equation shows that the series coil must be wound so as to oppose the shunt coils, and the number of series turns must bear to the number of shunt turns the same ratio as the sum of the resistances of the series coils and armature bear to the resistance of the shunt coils; this is on the assumption that there is no armature reaction; the field of a direct-current motor is strengthened by armature reaction, and therefore the number of shunt turns referred to above should be increased to an extent necessary to counteract the effect of the current in the armature. He also shows that when a motor is compounded for a certain constant speed, it is not compounded for any other speed; the specifications for such a motor should therefore state the speed at which it is to be run. He then discusses the current corresponding to the maximum electrical efficiency, and shows that the efficiency corresponding to the maximum output is equal to nearly one-half. His theory is illustrated by an example.

Foucault Currents. DÈSOMBRE. *L'Eclairage Elec.*, Feb. 20—A short article in which he calls attention to certain causes of Foucault currents in the pole pieces and in the conducting wires. There are two causes which produce these currents; the first is that the discs are not always absolutely flat, and the second is that in filing off the beard caused by the cutting of the discs, the thickness at the edges is not exactly the same all around the circumference; the lines of force pass from the pole pieces to the edges of the discs, and if these edges are not in exact planes the lines of force will oscillate in the direction of the shaft conforming with the slight bendings of the plates; if the air gap is very small these oscillations of the lines of force will produce Foucault currents in the pole pieces, which currents, owing to the low resistance, may become quite intense, producing much heat; by increasing the air gap this will diminish until the gap is so great that the irregularities in the disc will no longer have any effect on the relative distribution of the lines of force on the surface of the pole pieces. Supposing the discs to be absolutely flat the above described action will take place if the plane of the discs is not absolutely perpendicular to the axis of rotation; a displacement of the armature parallel to itself, as may be produced by the tension of the belt, also leads to an oscillation of the lines of force, but these oscillations are comparatively slow. The difference in the thickness of the edges of the disc caused by filing off the beard changes the magnetic reluctance at these points which, during the rotation, will then also give rise to oscillations of the lines of force. He shows that to avoid the production of these currents due to the causes described, the air gap should be a constant proportional to the diameter of the discs; in practice the air gap is generally made 0.03 to 0.04 times the diameter of the armatures. The currents caused by the disc not being plane are much more important than those due to the inequality in the edges. To these same causes may be attributed the Foucault currents generated in the copper wires on the armature. He discusses the action in the interior of the armature core and shows that there are no evil effects there; the causes of these currents cease at a very small distance within the circumference, from which he concludes that in armatures in which the conductors pass through holes near the circumference, solid copper bars can be used without fear of heating due to eddy currents.

Three Wire Dynamo. KENNY. Lond. *Elec. Rev.*, Feb. 26.—A discussion of the dynamo described by Rothert in THE ELECTRICAL WORLD, Nov. 7, page 569. He enumerates what he considers to be the requirements of such a dynamo, and endeavors to find how they are satisfied by this arrangement. By connecting the windings of the opposite poles in series he thinks the first two conditions are realized, namely, that each side of the armature is capable of independent adjustment from full to no load, and that it admits of the more heavily loaded side being of considerable higher pressure than the other. The third requirement is that the two halves should be able to be coupled in multiple, and he claims that to accomplish this there should be two wound poles and two unwound, as was suggested some time ago by E. Thomson. The fourth condition is that no coil should be overloaded when either side alone is fully loaded, that is, when the current in the neutral wire is equal to the maximum rate of output of the dynamo on the balanced circuit; this, he thinks, is not fulfilled, but suggests the use of two neutral wire brushes, diametrically opposite to each other; the balancing property of the armature would then be entirely removed; but, if a ring armature is used and the two adjacent but unlike magnets connected in series, two neutral brushes could be used; if this can be done, then the positive and negative brushes could be connected together, if desired. His discussion does not apply to the case of a separate three-wire plant, but to the case when the machine is used for balancing, together with several larger units working on the outside conductors.

Iron for Transformer Cores. CLINKER. Lond. *Elec.*, March 5.—A short communication regarding the ageing of transformer iron. Extensive tests have been made by a large company during the last six months, and it was found that the change is not common to all kinds of iron; heat is the sole cause of this ageing; iron requires many weeks to arrive at a steady stage. The worst sample increased its hysteresis loss to nearly 3.5 times its original value; the best iron to stand the effect of continuous heat is of the nature of mild steel; this also has the greatest specific resistance, which reduces the eddy currents; the General Electric Company of America uses steel sheets.

LIGHTS AND LIGHTING.

High Voltage Lamps.—Lond. *Elec.*, Mar. 5.—An illustrated description of a number of different European lamps. It seems that the method of supporting long filaments by wires fixed to the globes has been generally abandoned, the objection being the expense and the injury to the filament at the point of support; the standard types mostly have two filaments; to prevent the filament touching the globe requires an increased size of the globe; the Zurich Company will use a sinuous filament; in another form the M-shape filaments are used, on account of their greater rigidity; a defect of the double filament is the risk of their becoming entangled during transit; a smaller globe can be used if the two filaments are side by side, instead of in the same plane, and the illumination is more uniform; the makers recommend efficiencies of 3.5 to 4 watts per candle; the relation between life and efficiency is claimed to be exactly the same as for the low-voltage lamps. A table of the resistances of the filaments when cold is given.

Projectors. PRETTY. Lond. *Elec.*, Feb. 26.—A continuation of his serial; he gives directions for operating the lamps. To protect the projector and operator in the case of war, he describes a simple arrangement, in which they are placed behind a turret or earthwork, the light being directed on an adjustable plain mirror of silvered copper, which is above the earthwork, but easily adjusted from below.

POWER.

Local Distribution in Workshops. SCOTT. Lond. *Elec. Eng.*, Feb. 26.—The continuation of his serial. The present portion is composed entirely of what appears to be a very good collection of data for calculating the power of iron working and wood working machinery; in the case of iron working machinery, for instance, the figures are given by which the weight of metal removed per hour in pounds must be multiplied to get the required horse-power; this constant is given for the various metals (the authorities for this data are not given; it appears as though the data was obtained by driving these various machines by means of electric motors, and measuring the electric power).

Electric Rock Drilling. SNELL. Lond. *Elec.*, Feb. 26.—An illustrated article, abstracted from the French, giving a description of a mining plant presenting some novel features. The power unit consists of a 50-hp Pelton water wheel, directly coupled to a three-phase alternator; the transmission is over a distance of 2000 yards; an illustration of the portable drill is given; three drills are secured to a common frame, each having its own motor connected with a jointed shaft; the drills can be set to work in any direction.

Gold Dredging.—Eng. & Min. Jour., March 13.—An illustrated description of the dredging plant at Bannock, Montana, which contains the first dredge for this purpose operated by electric power; the power is furnished by water brought from a river, sixty miles distant, through an iron pipe; the turbine has a capacity of 200 horse-power; with it gold to the amount of half a million is said to have been recovered during the past year; the success has warranted doubling the dredging plant.

Wave Motor.—West. Elec., March 13.—A note stating that the Wright wave motor has recently been tested on the coast of California, and that five horse-power was easily generated; a float operates a hydraulic compressor, the water of which operates a Pelton wheel, which drives an electric generator; during storms no more than a given amount of pressure can be accumulated; he claims that during a minimum wave movement one horse-power can be developed for every foot of ocean frontage. No further description is given.

TRACTION.

Conduit Railway System.—In the *Digest*, Dec. 12, a brief abstract was published of a note on a report of tests made of an experimental line in Hamburg, constructed according to the Lachmann system; the statement was made in our abstract that "the car came to rest while it was passing through the flooded portion" of the track; this was an almost literal translation of the statement made in the original note, which was that "the car stopped," and not that it was brought to a stop purposely. We have now been shown a letter, just received from Prof. Voller, of Hamburg, who made the original report, in which he explains that the car did not come to a stop by itself while passing through the flooded portion, but that it was intentionally stopped at that time, in order to measure the loss due to the effect of the water. We are pleased to be able to add this authoritative statement.

New Overhead System. Bochet. Lond. *Elec.*, Feb. 26.—A note from a recent paper read in Paris. Instead of the unsightly trolley wire, he slightly less than a train of cars; these are either placed on special supports or on street lanterns; the car carries a contact bar, which touches one contact before it leaves the other.

Electric Railways.—Lond. *Elec. Eng.*, Feb. 26 and March 5.—Brief descriptions of the Elberfeld-Barmen and the Remscheid railways, taken suggests using overhead contacts, the distance between which is from a recent report made for the City of Sheffield.

Electric Railway Statistics for Germany.—Lond. *Elec.*, Feb. 21.—A translation of the complete set of tables which were noticed in the *Digest*, Jan. 30.

Electricity for Suburban Railway Traffic. Wallace. *Elec. Eng.*, March 10.—An abstract of a recent paper read before the American Society of Civil Engineers, giving the chief results of a careful study made in 1892 in preparing to handle the World's Fair traffic in Chicago; it is not offered as a solution of the problem, but merely to give the facts as ascertained by that inquiry; the data consists in answers from five different companies to a series of forty-five questions (being now five years old, they have lost considerable interest).

Surface Contact System in Paris.—West. Elec., March 13.—A brief illustrated description, taken from a French journal, of the Claret-Vuilleumier system, which has been installed in Paris, descriptions of which have frequently been referred to in these columns; in the new system contact is made with blocks, placed between the tracks, which are connected to the circuit, temporarily by the cars by means of a system of distribution boxes.

Electric Hansom.—Sc. Amer., March 13, and *Elec. Eng.*, March 10.—A brief illustrated description of the cab, several of which are about to be put in public service in New York City; it is expected that in a short time there will be twelve in regular use.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Water Power Station at Worcester.—Lond. *Elec.*, March 5.—An editorial discussing this plant, in which the power is derived from a river having only a moderate fall; one-quarter of the plant is dependent on the water power, while three-quarters can, under favorable conditions, be so driven; three-quarters of the maximum power can be developed by steam alone; the capital outlay is therefore quite high, namely $610 per kilowatt. It is stated that the past year shows that the use of the water power was justified; the proportion between the standing and the running charges is exceptionally high, the latter representing only 12.5 per cent. of the total cost. All the lamps run for more than 1.5 hours per day were a source of profit at the rate of 9 cents per unit, while all those used less were a source of loss; the reports show a deficit of $9000; it is thought that this is a case where a uniform tariff is quite hopeless; the Wright system of charging is thought to be the most advisable one, and better in this case than the Hopkinson system; a charge of 12 cents per unit for the first hour's daily average use and of five cents for all excess is recommended; the daily average use, in order to show a profit, must therefore be slightly more than one hour.

High vs. Slow Speed.—Lond. *Elec. Rev*, March 5.—A short communication in which the following statements are made. The lowest recorded works cost in the United Kingdom have been obtained with high-speed machinery; the highest costs were obtained with slow-speed machinery; a marked diminution has been effected in the coal bill of one station since the introduction of high-speed machinery; the company whose good results have been obtained with the slow-speed plant are now adopting high-speed machinery on a large scale.

Capital Expenditure in Electric Supply Stations.—Lond. *Elec.*, Feb. 26.—A supplement in the form of a large two-page table. The table gives the name of the district, the population, owners, date of commencement and amount expended up to January, 1897. In a concluding note, it is estimated that a total of $60,000,000 has been invested in electric supply stations in the United Kingdom; twelve stations are in course of construction.

Lighting the Shop. Pratt. Lond. *Elec. Rev.*, Mar. 5; reprinted from *Machinery.*—A short article of a semi-popular nature, in the form of advice to machine shop owners. If light is needed for only a few hours a day and the plant is fully loaded it is cheaper to use the current from a central station, but if the plant is not loaded and the light is used for several hours, it would pay to make the necessary installation; ten incandescent and two arc lamps are taken to correspond to one horse-power; both kinds of light should be used, but the arcs should be run on the incandescent circuits, and therefore a compound-wound potential dynamo of 110 volts is preferable, or at 220 if much power is transmitted to motors. If necessary to install a steam plant, it should be direct-connected. General hints regarding the rest of the plant and its maintenance are given.

Lighting Plants for the British Navy.—Lond. *Elec.*, March 5.—A brief illustrated description of the combined engine and dynamo used on several ships; the dynamos are iron-clad.

Fort William.—Lond. *Elec. Rev.* and *Elec. Eng.*, March 5.—A short illustrated description of this small water-power plant with which accumulators are used.

Bowling Green Storage Battery Station.—Elec. Eng., March 10.—A well-illustrated description of the auxiliary plant at Bowling Green, New York City, in which the batteries are used as independent distributors fed from the Duane Street Station about a mile distant, over four feeders; it takes the place of an annex dynamo station formerly used; the feeders can also be used as tie feeders during the hours of light load and as distributing feeders during the hours of maximum load, thus effecting a considerable saving in investment; this plant makes it possible to shut down the Duane Street Station during the hours of minimum load, thereby effecting an economy in operation. The battery consists of 150 cells having a capacity of 2000 amperes per side of 75 each, for one hour, or 1000 amperes for three hours, or 400 for ten hours, the charging rate being 400 amperes; there are twenty regulating cells at the end of the positive and negative sides, enabling the battery to be charged and discharged simultaneously or discharged at different potentials; a booster is used and is described, as are also the switchboard and other accessories.

WIRES, WIRING AND CONDUITS.

Wiring. Bonfante. *L'Eclairage Elec.*, Feb. 13.—A short report of a recent paper in which he calls attention to the rare but possible case of a double arc formed by two ground connections of the leads in the wiring of the building; in such a case the two arcs may continue to burn for some time without blowing the fuse. As a remedy he recommends running the two leads closer together, so that the arc will take place between the conductors, in preference to passing through the ground from one to the other, and in that case a short circuit would be immediately produced which would blow the fuse.

Best Form of Conductors for Discharges. Cardani. *L'Elettricista*, December.—The results of extended researches which lead him to the following conclusions: Metallic strips have a much lower (apparent) resistance than wires of the same section; that of wide strips is proportional to their thickness; under ordinary circumstances the surrounding dielectric does not affect the result; there is but little advantage in using a stranded conductor, as it behaves like a solid conductor, whose cross section is equal to the sums of those of the single wires; the result is not materially changed by the use of insulated wires; the best arrangement to conduct discharges is to use conductors in multiple, provided they are kept far enough apart so that the conductance of the multiple conductors is equal to the sum of the conductances of the single branches.

ELECTRO-PHYSICS AND MAGNETISM.

Latest Discovery in Physics. Lodge. Lond *Elec.*, Feb. 26.—An article under this heading in which he calls special and favorable attention to the recent discovery of Zeeman, of Amsterdam (see *Digest* March 6; also the paragraph below), in which the lines of the spectrum were seen to broaden due to the action of magnetism; Lodge attaches considerable importance to this discovery; this agrees exactly with the theory of Lorentz concerning the nature of radiation, the whole of his prediction having been fulfilled to the letter. The importance of the discovery lies in its theoretical bearing, in the evidence it can furnish as to the nature of the motions which enable matter at high temperature to disturb the ether, and in the conclusion that can be drawn from it as to the physical nature of a radiating or absorbing body. The discovery will probably substantiate and establish the idea that radiation is excited by the motion of electric charges. He concludes with an elementary treatment of a general idea of the Lorentz theory.

Influence of Magnetism on the Nature of the Light Emitted by a Substance. Zeeman. *Phil. Mag.*, March.—An article describing the discovery referred to in the paragraph above and noticed briefly in the *Digest*, March 6.

Thermo-Electric Properties of Liquid Metals. Burnie. Lond. *Elec.*, and *Elec. Rev.*, March 5.—An abstract of a physical society paper. He investigated the effect of melting on the thermo-electric properties of certain metals; they were placed in a W-shaped glass tube, one limb of which was heated and the other cooled, the terminals being copper wires; the results are given in curves, which are not reproduced; the slope depends on the rate of cooling or heating, especially with bismuth; it is less marked with tin and absent with lead; at the melting point there is considerable change in the slope—smallest for lead, greater for tin and remarkably large for bismuth.

Discharges in Discontinuous Conductors. Vicentini. *Nuovo Cimento*, January; abstracted briefly in the Lond. *Elec.*, March 5.—Using a 30-cm spark Holtz machine he operated on emulsions of mercury in olive oil and essence of turpentine; there was a differential action between the continuous liquid and the drops of mercury, which led to the formation of larger drops of metal condensing the emulsions, so that the liquid moved heavily between the drops; on discharge the liquid suddenly contracted, leaving behind small portions, which executed extraordinary motions around straight nuclei of mercury as centres. The experiments are said to throw considerable light on the behavior of coherers made of metallic particles in air.

Conductivity of Hot Gases. Petinelli and Marolli. *L'Elettricista* October.—A description of researches made with 100 volts to determine the conductivity of flames and of gases heated in closed tubes. They found that the conductivity varies according to the nature of the negative electrode only; Ohm's law does not apply; at 600°C the gases begin to allow measurable currents to pass and at 800° they are ten times as great, after which the increase is not as rapid; different gases under similar conditions showed nearly the same conductivity; it seems that the conductivity is due only to a kind of convection phenomenon.

Electro Capillary Experiment. Chassy. *Jour. de Physique*, January; noticed briefly in the Lond. *Elec.*, Feb. 26.—A small vessel contains mercury and acidulated water; a positive terminal dips into the water, and a negative terminal enters the mercury; a tube several centimeters wide passes through the acidulated water, and dips slightly into the mercury; when the current passes, the water filters past the plug of mercury and gradually rises in the tube; it can be made to overflow, and in one instance 700 cubic cm were filtered through in an hour; the voltage must be sufficient to produce well-marked electrolysis; the

flow starts at a certain minimum current, and gradually approaches a maximum rate as the current increases.

Rotation in a Constant Electric Field. QUINCKE. *Proc. Lond. Phys. Soc.*, February.—A long abstract from the *Wied. Ann.*, 59, p. 417, of the article which was noticed in the *Digest*, March 6.

Contact Electricity. WIEDEBURG. *Proc. Lond. Phys. Soc.*, February; abstracted from the *Wied. Ann.*, 59, p. 742.—A theoretical discussion.

Photographic Action of X-Rays. VANDEVYVER. *Jour. de Physique*, January; noticed briefly in the Lond. *Elec.*, Feb. 26.—He gives some data; the necessary exposure varies as to the cube of the thickness of the intervening material; the photographic action varies inversely as the distance and not as the square of the distance. It is suggested in the abstract that these generalizations are probably made from insufficient data.

Magnetization Limit of Wrought Iron. WILDE. Lond. *Elec. Rev.*, Feb. 26.—A short communication referring to the figure obtained by King in his experiments with a large magnet made of guns, with which he found that 400 lbs. per square inch was obtained as a tractive force. The present writer calls attention to some experiments which he described in 1891, to determine the magnetization limit; he obtained 381 lbs. per square inch, which is about the maximum.

Circular Lines of Force. HAYCRAFT. Lond. *Elec. Rev.*, Feb. 26.—He calls attention to the fact that no illustration is published in text-books of the circular lines of force in a circular solenoid; he gives an illustration of the apparatus which he used, which consisted of an open circular coil, in the interior of which was a split ring of white cardboard, on which the iron filings were strewn, to show the lines of force.

Practical Aspects of Electrical Resonance. MILLER. *West. Elec.*, March 13.—A reprint in full of a paper read before the Chicago Electrical Association. He describes in clear, easily understood language the underlying principles of resonance, without resource to mathematics; some mechanical analogies are given; the first part of the paper is summarized from writings of well-known physicists, and makes no claim at originality; in the second part the outline of an automatic speed governor, depending on resonance, is described, as also the Hutin and Le Blanc system of multiplex telephony, which he says is, with only one exception, the only pure multiplex system yet devised (it was described some years in these columns, and is based upon synchronism, combined with electric resonance); it is ingenious, but impracticable.

Influence of a Static Charge on the Surface Tension of Water. NICHOLS and CLARK. *Phy. Rev.*, March-April.—An article of some length, describing an investigation to determine quantitatively the influence of an electric charge on the surface tension of water; experiments are described from which the conclusions are drawn that the surface tension of water is decreased by giving it a static charge of electricity; and that the law of decrease is independent of the nature of the charge; they believe that a like influence is exerted on the surface tension of other liquids.

Mechanical Conceptions of Electricity and Magnetism. FRANKLIN. *Phys. Rev.*, March-April.—An article describing some developments based on the conceptions of Maxwell; the conceptions here developed, it is claimed. do not seem to have been pointed out before except in a general way. The fundamental conception is that ether is to be considered as built up of very small positive and negative cells, in such a way that only unlike cells are in contact; the cells are conceived to be so connected when in contact that if a cell be turned while the adjacent cells are kept stationary, then a torque due to the elastic reaction of adjoining cells is brought to bear upon the turned cell, which tends to right it and which is proportional to the angle turned. The article is written and illustrated in such a way that it is not difficult to understand.

X-Rays. W. D. HERING. *Pop. Science Mo.*, March.—An article of a general nature describing in a popular way the history of the Rontgen phenomena during the past year, but containing nothing new. He states that very little has been added to the facts brought out by Rontgen; their true nature is still a mystery, but it is known now that the rays are not homogeneous and differ among themselves in their properties, like the rays of light; among the various theories that have been suggested, the theory that they are ether rays like ordinary light, but of exceeding brief period, is the one which is at present the most plausible; the various types of tubes are discussed, and the general method of operation is described.

Effect of X-Rays on the Hair. KOLLE. *Elec. Eng.*, March 10.—An article describing a typical case which has come under his notice; he recommends treating the area exposed to the rays at once with stimulating drugs; these were applied to that case with success; he shows that the nerves of the follicles are not destroyed, as was supposed, and in this the action differs from the depilatory action of the direct current.

New Röntgen Ray Lamp.—Elec. Rev., March 10.—A reprint of the description of the new Siemens & Halske lamp which was noticed in the *Digest*, March 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity in Chemical and Metallurgical Industries. KERSHAW. Lond. *Elec.*, March 5.—A continuation of his serial (see *Digest*, March 6). He discusses gold and silver. The electrolytic extraction of gold is of very recent date, the first industrial application having been made in South Africa in 1894, since which time progress has been very rapid, and it is now probable that the electrolytic processes will in time entirely displace the zinc precipitation. The three processes at present used are all worked in conjunction with the cyanide process, the difference between them being merely in details of the cell and the method of working; gold cyanide solution is electrolyzed, depositing gold on the cathode; a list is given of the six companies using these processes, with some few details. In the Siemens & Halske process the solution is passed through a series of cells with iron anodes and lead cathodes, a current density of 0.06 ampere per square foot is used, the voltage being 4, the gold on the lead being recovered by cupelling; this is the process used in South Africa; the Eltonhead process differs from this in the use of lead as anode and mercury as cathode, the cyanide solution being passed through the cathode department and a saturated alkaline solution being used in the anode chamber; Langhammer's process is used with gold bearing quartz for saving the fine gold; iron anodes and lead cathodes are used. The objections to this and the first process are the conversion of iron into Prussian blue and the necessity of cupelling large amounts of lead; although successful, the processes have not reached their final form. The Siemens & Halske process is said to cost from 58 to 75 cents per ton of tailings treated, with a plant for 3000 to 6000 tons monthly; between 70 and 80 per cent. of gold is recovered; the power represents only 10 per cent., so that the question of the cost of the energy is not worth considering; the Eltonhead process is said to cost 50 cents per ton, but this requires confirmation; the cost of the zinc process is said to be from 75 cents to $2.50 per ton. The process for silver is essentially that described by Watt in 1851; the plant of the Pennsylvania Lead Company, near Pittsburg, produces 40,000 ounces of refined silver daily; a table gives a list of the six companies using the process patented by Moebius; the anode material is usually an alloy of gold and silver, and the electrolyte is dilute nitric acid or nitrate salts of silver and copper, slightly acid; the current density is 32 amperes per square foot and the voltage 0.37; an automatic scraper removes the silver crystals formed; the lead, antimony and copper remain undissolved. The Tomassi process is just emerging from the experimental stage; the electrolyte is a double acetate of lead and sodium or other alkali, and the lead is deposited on a revolving cathode while the silver remains insoluble. No details as to cost are given, but the question of current and energy efficiencies is entirely of a secondary nature; the processes are preferred on account of simplicity and cleanliness even though the cost might be higher.

Aluminum Industry. LEEDS. Lond. *Elec.*, March 5.—A criticism of the recent statement by Kershaw (see abstracts of his recent articles) in which was prophecied a great revolution in the next decade; the present writer endeavors to controvert this prophecy on the ground that harm may thereby be done to the industry. At present there is really only one method in use; it is highly probable that bauxite will remain the only available ore, as clay contains too little of the metal and too much silica, and cryolite is difficult to procure or reduce and is too impure; several of the suggestions made are said to be visionary, and it is thought that the only alterations in the present method which are likely to take place will be in details, effecting a decrease in price; if the present price could be reduced to one-half, aluminum would immediately become available as a conductor in the place of copper.

Refining Bismuth. ZAKORSKI. Lond. *Elec. Rev.*, March 5.—A note stating that he used impure bismuth as an anode and pure bismuth, platinum or carbon as a cathode, in nitric acid as an electrolyte, with a current density of 15 amperes per square foot; the deposit may be easily removed from the cathode.

Theory of Liquid Cells. LOVEN. *Proc. Lond. Phys. Soc.*, February; a notice from the *Zeit. f. Phys. u. Chem.*, 20, p. 593.—He applies Nernst's theory of the electromotive force of the cell, to solutions which contain ions of more than monad valency; the experimental results are slightly above the calculated values. A brief abstract of what appears to be the same paper is contained in the Lond. *Elec. Eng.*, Feb. 26.

The Lead Cell. MOORE. *Phys. Rev.*, March-April.—A long article on the theory of the action in the lead accumulator, the first part of which is theoretical and the second part experimental; it is largely intelligible only to those who are familiar with the present hypotheses of electrochemistry; the theory of Le Blanc is enlarged upon and certain experiments suggested by that theory are given. The fundamental principles of Le Blanc are the theory of free ions, solution tension, and osmotic pressure, upon which rests the Nernst theory of electromotive force. When fully charged, lead per oxide should be in solution at one electrode, and at the other there should be "spongy lead particles in solution"; the process gives the formation of sulphuric acid at both electrodes and the extraction of water at the electrode where water had been formed in the discharging process; the tetravalent lead ions pass over into bivalent lead ions during discharge, which is the principal source of the electromotive force in the cell. Considerable use is made in the discussion, of the solution tension of the electrode substances and the osmotic pressure of the ions; the thermo-dynamical considerations are discussed, and it is shown that practically the same form as the Nernst formula is obtained therefrom. In the experimental portion of the paper the results of a large number of carefully made experiments are given in tables and curves, and are discussed; special attention was given to the action during the first few seconds and the recovery, both by charging and discharging; continuous curves are given for charges and discharges following each other without intermission, showing the recovery; in general, the curves show great regularity, and their character is in harmony with the theory; the drop in the E. M. F. on closing the discharge or the rise on closing the charging, does not by any means take place instantaneously. The deductions are not of a nature enabling them to be abstracted here, and no general conclusions are drawn except in the last paragraph, in which it is said that with large currents it is quite impossible to get a high efficiency owing to the establishing of a concentration series and the large changes which the osmotic pressure of the ions and the solution tension of the electrode substances undergo; these, he says, are inherent difficulties too little recognized in the electric storage car problem.

Haemoglobin Carbon Cell. Case. *Elec. Eng.*, March 10.—Reports of a recent test of this cell which he mentioned in his recent paper. With carbon and platinum in this solution he obtained 0.06 volts; after exposing the electrode to the air this was raised to 0.07 volts; adding potassium hydrate raised it to 0.08; platinum and animal charcoal gave 0.12; this shows that the haemoglobin acts as a carrier of oxygen and oxidizes the carbon; it cannot be used in practice, as it decays in two or three days.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Mercury Interrupter for Induction Coils. Londe. Lond. *Elec. Rev.*, Feb. 26; translated from *La Nature.*—An illustrated description of an improved form of Foucault interrupter which has great advantages for induction coils. In this form the circuit is broken by a rod dipping into mercury over the surface of which is placed alcohol and water, the wire being operated by an independent electric motor, the speed of which can be regulated; the rod is lifted by means of a cam so proportioned that the duration of the contact is three-quarters of the period, that of the interruption being only one-quarter, which proportion gives the maximum efficiency.

Disturbances in Magnetometry. Du Bois. *Proc. Lond. Phys. Soc.*, February; abstracted from *Ver. Phys. Ges.*, Berlin, 15, p. 102.—He reviews the standard methods for dealing with fluctuations in the terrestrial field, and proposes another, of the unipolar vertical magnet type, in which an astatic combination is suspended with one magnet in the line of maximum meridional horizontal components of an ellipsoidal magnet, while the other is in the equatorial plane of the same. The method is based upon discrimination between the variations from point to point in the local field, and the nearly uniform character of the terrestrial fluctuations throughout that field.

Use of the Secohmmeter in Measuring Co-efficients of Self Induction. Colard. *L'Eclairage Elec.*, Feb. 20.—He gives a brief discussion of how these co-efficients are usually measured and then shows that the two characteristic methods of measuring based on the comparison of two co-efficients of self-induction, allow the legitimate use of the secohmmeter, even when the discharges are incomplete; but this is not the case with processes based on the comparison of a co-efficient of self-induction and a capacity combined with resistance; the article is to be continued.

Synchronous Motor for Determining the Frequency. Moler. *Phys. Rev.*, March-April.—A short, illustrated description of a small apparatus for measuring the frequency of an alternating current; it consists of a synchronous motor brought up to speed with a crank and gearing; the proportions are such that the speed counter gives the frequency directly without further calculation; there are two electromagnets operated by a clock, closing a circuit once a minute, the counter being therefore operated only for exactly one minute; at the end of this time the magnet throws a catch into some one of twenty teeth, which enables the reading to be taken to 5-100 of an alteration; the whole apparatus weighs but 8.5 lbs.

Idiostatic Electrometer. Barus. *Phys. Rev.*, March–April. — A short article describing a possible development of this form of electrometer. Although this form of instrument has not been developed like the quadrant electrometer, yet it is apparently the more reasonable, as it introduces no foreign potentials; he describes certain results obtained in an endeavor to perfect this instrument; of the two available forms, the gold leaf and the condenser type, only the latter gave results worth describing; in an extreme case such an instrument should register as little as 100 micro-volts.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Rapid Cable. Dearlove. Lond. *Elec.*, Feb. 26. — A short article on the suggestion of Prof. S. P. Thompson. The question is whether leaks or shunts inserted between the two wires of a complete metallic circuit without earth connection, are the solution of future high speed ocean telegraphy; he has had opportunities of making many trials of leak circuits on artificial lines and on actual cables worked by the usual system, and in both cases the results were disappointing; some of these results are given, and show that in practice the introduction of leaks give improved definition and that the resistance of the leak most suitable to the particular cable was from 4000 to 6000 ohms, or about one-quarter of the total conductor resistance; with this the speed was increased from 42 to 48 letters per minute; with 1000 ohms the definition was fairly good, but the signals were too small; trials made on an artificial line with inductive, as well as non-inductive leaks, were equally unpromising. These results show that no large increase of working speed is to be attained without considerable modification of the usual terminal conditions; this refers to circuits having leaks between the conductor and the earth, but he thinks it is quite possible that complete metallic circuits having leaks, or shunts, may also prove disappointing.

Rapid Cable. Rymer-Jones. Lond. *Elec. Rev.*, March 5. — A short article on the suggestion of S. P. Thompson. His conclusions are similar to those which have already been reported; he admits that there will be a certain increase due to leaks, but that it is certainly not as large as claimed by Thompson; the results so far obtained from tests do not come up to the claims. He gives the results in the form of messages as received on a long artificial cable provided with leaks; with signalling condensers at one or both ends there is no important difference if the leak is placed in the middle or near either of the ends; this is shown by the curves; low resistance leaks reduced the size of the signals, thus requiring a greater battery power. To what extent these results may be compared with those obtainable from a twin core, may be open to question, but they do not seem to promise any very great increase in speed. A test might easily be made with coast cables by inserting leak resistances at the intermediate stations.

Novel Method of Raising a Buoyed Cable End. Taylor. Lond. *Elec.*, Feb 26.—A brief description of a new method which has important advantages over the one in general use and has been adopted by a recent expedition. The ship passed out about 200 fathoms of buoy rope with a centipede grapnel attached to the end of it, and then steamed around the buoy at a distance of about 50 fathoms until the centipede and the rope became entangled with the buoy moorings.

Brazilian Government Telegraph System.—Lond. *Elec. Rev.*, Feb. 26.—The beginning of an abstract from the official report for the year 1898, translated from the *Jour. Telegraphique*, Dec. 25.

Microphonograph. Dussaud system. *Elec. Eng.*, March 3; reprinted from *La Nature.*—A brief illustrated description of an apparatus to magnify the voice just as a lens magnifies objects to the eye; (the analogy does not seem to be a good one, as the magnification seems to be more like that produced by a telegraph relay); it is intended to be used for the deaf and for the study of feeble sounds given out by healthy and diseased organs of the body. The register appears to be a modified phonograph, the diaphragm of which is vibrated by small electro-magnets, the currents for which are obtained from a microphone; the repeater is a somewhat similar instrument with a microphone attached to the membrane; the current for this is obtained from one to sixty cells and thence passes to a telephone; thus the intensity depends on the amount of current passing. The education of deaf mutes by means of this instrument is now being carried on; it is admirably adapted for studying the action of the heart; a ten months' treatment of a young deaf mute has shown that the auditory nerves and auditory apparatus have been greatly stimulated to activity by the use of this apparatus, the number of cells required having been reduced from twenty-two to two during that time. A large apparatus of this kind is being constructed, and is intended to make the voice heard by 10,000 persons; it is intended for the Paris exhibition of 1900.

Telephony in Stockholm.— West. Elec., Mar. 6.—A brief description of a system in that city where the telephone is said to be proportionately in more general use than in any other place in the world; notwithstanding very low charges a good dividend is paid after allowing a large reserve fund.

Submarine Telegraphy. Mance. *Ind. Rub. World*, March 10. — An abstract of that portion of his recent address (in London) giving the historical features and referring to the business of cable insulation.

MISCELLANEOUS.

Prevention of Racing in Marine Engines. Harlan. Lond. *Elec. Rev.* Feb. 26.—An illustrated description of an arrangement devised by Yabsley and used on the Japanese steamer "Kaisha," on which it acted very satisfactorily, anticipating the rising and falling of the propeller. The device closes and opens the throttle valve; a pipe is fitted to the stern of the vessel as near to the bottom as possible; the variable air pressure in this pipe operates an electric contact in the circuit of a motor or magnet which acts on the slide valve of a small steam cylinder connected with the throttle valve.

India Rubber and Gutta-Percha. Dooley. *Pop. Science Mo.*, March. — A long article giving an interesting history of these materials and their properties.

Foreign Duties on Electrical Machinery and Lamps.—Elec. Eng., March 10, and *West. Elec.*, March 13.—A table similar to the one noticed in the *Digest*, Feb. 6.

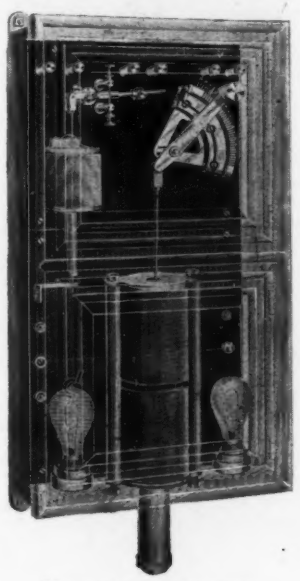
Educational.—Elec. Eng., Mar. 3.—An illustrated description of the electrical laboratory in the new Hebrew Technical Institute in New York City, which was recently opened and which will accommodate thirty pupils.

Effect of Electricity on Seeds.—Elec. Rev., March 17.—A reprint of the conclusions in a recent report of the Massachusetts Agricultural College in the form of a paper by Kinney (in some of these conclusions he gives the strength of the current in "volts" and there is nothing in the reprint to show what he really meant to say); among his conclusions the following may be mentioned: "Electricity" exerts an influence on the germination of seeds; certain current strengths for short periods accellerate the process of germination; seeds thus treated have a higher percentage of germination; the range of the current strength which exerts a favorable action is exceedingly limited (but he also states that the minimum is "considerably less than one volt" and the maximum "a comparatively high voltage"); one application has an effect for only a few hours and the beneficial effect is lost as the plants mature; when applied hourly to germinating seeds or growing plants, the effect is not lost, but acts as a constant stimulation.

Burglar Alarm for Safes. Kammeyer. *Elec. Rev.*, March 17.—An article entitled "The Modern Burglar," in which he gives some reproductions of photographs of safes "successfully attacked" by means of a few feet of wire and a rod of carbon; the holes were made in less than five minutes and the current was taken from 220-volt central station mains, the current being 250 to 350 amperes and the voltage 50 to 80; the holes were burned through by means of the electric arc; a hole was burned through a wall of seven inches of drill-proof steel in less than thirty minutes; the electrical current furnishes from 9000 to 10,000° (sic) of heat; the illustrations show some safes with holes through them. This is followed by a brief description of a new system of electric protection of safes, the principal features of which are that the alarm is sounded in a street box in front of the building; that the lining of the vault to be protected consists of alternate layers of insulating material and tinfoil conducting strips; that the cable used consists of thirteen thin strands of wire separately insulated and braided together, making it impossible to tamper with the conductors for making the system inoperative; any tampering with the vault lining or any point of the system operates the alarm; the description is only of a general character.

A New Voltage Regulator.

The efficient and economical operation of an incandescent lighting plant involves the nice adjustment of two opposing factors of expense. On the one hand, the life of the lamps supplied can be extended at the expense of current, a lamp of high watt consumption lasting, other things being equal, considerably longer than a lamp of low consumption, and vice versa. With lamps working at 2½ watts to the candle-power, unless the regulation of voltage is exceedingly close, the life of the lamps is very short, and the high economy in operation which re-

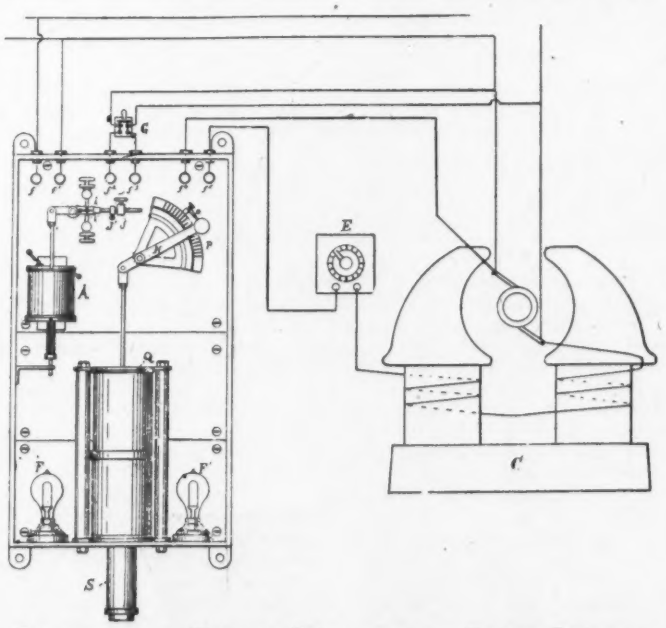


VOLTAGE REGULATOR.

sults from their use is offset by the increase in the bills for lamp renewals.

Appreciating this situation, the Belknap Motor Company, Portland, Me., has put upon the market the new Chapman voltage-regulator, which is here illustrated. The large number of these already in use has demonstrated the excellent work which they can do under all conditions of station practice.

The regulator consists essentially of a field rheostat whose moving arm is worked by a solenoid. This solenoid is controlled by a relay solenoid which operates a set of contacts that govern admission of the current to the sections of the working solenoid. This is differentially wound and is composed of four distinct coils, two of which have a small continuous current flowing through them in opposition to each other, the other two, when the circuit through them is closed by the

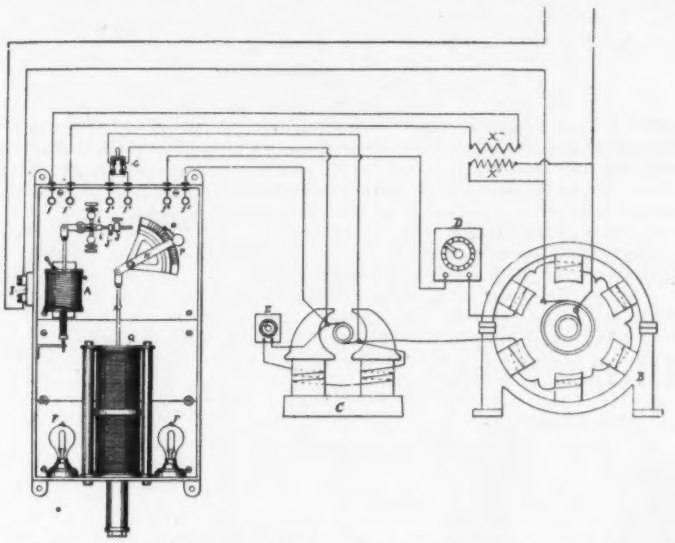


CONNECTIONS OF VOLTAGE REGULATOR FOR DIRECT CURRENT.

relay magnet, serving to neutralize one section of the continuously excited solenoid coils. This method of operation avoids the injurious sparking which would follow the breaking of the circuit of the main solenoid, and provides for the prompt action of the mechanism in case of a break in the connecting circuits. It also completely neutralizes the induction discharge of the large coils, and limits the spark to the smallest size. By this means a very close adjustment of the contact points of the relay can be secured, and with this a very sensitive regulation.

The device is enclosed in a dust-proof iron case having glass doors in the front, which give easy access to all the parts. The solenoid cores are composed of bundles of small gauge iron wire, insuring quick and efficient action. Two lamps in the base of the case furnish a non-inductive resistance for the relay circuit.

In stations where it is desired that the voltage should rise with an increase of load, which is sometimes effected by hand regulation of shunt-wound machines or over-compounding of the generators, the same result can be secured with simple shunt machines by compounding the auxiliary relay magnet of the regulator, and by this very ingenious



CONNECTIONS OF VOLTAGE REGULATOR FOR ALTERNATING CURRENT.

method the advantages of a compound machine can be secured at very small outlay. Used in connection with an old-style alternator, having no compounding coils on its field, this apparatus enables such a machine to compete successfully with modern types. The energy consumed in the regulator is practically negligible, 60 or 70 watts being quite sufficient for a large regulator.

These regulators are made both for direct and alternating-currents and arranged to work under any conditions of frequency or voltage.

A Portable Testing Set.

A testing set designed for accurate work, and at the same time small and light enough to be easily portable, and strong enough to stand the rough usage entailed by out-door use, has been placed upon the market by Messrs. Queen & Co., Philadelphia, Pa.

This set, known as the "Acme," consists of a battery of six cells in a

TESTING SET.

removable box, a galvanometer, and a Wheatstone bridge and rheostat. The galvanometer is of the D'Arsonval type, the movable coil being mounted on jewels. With a resistance of less than 300 ohms it has a sensibility of 0.5 megohms—or, in other words, that a deflection of one scale degree will be caused by one volt acting through this resistance. The battery is of the silver-chloride type, the ease of adding a number of outside cells if required being the reason for limiting the equipment of the set to six cells.

The bridge coils are in two pairs, adjusted to an accuracy of one-tenth of one per cent. The rheostat is adjusted to an accuracy of one-fifth of one per cent., but when desired this adjustment can be carried to one-twentieth and one-tenth per cent. respectively. The rheostat is divided into twenty-four parts, giving a total effective range of measurements from one-tenth ohm to 5 megohms.

The set is only nine inches long, and very light. It was well described in an article on "The Range and Accuracy of Wheatstone Bridge Measurements," by Irving B. Smith, in the last number of THE ELECTRICAL WORLD.

Dry Batteries.

The first dry-cell battery that attracted any attention in this country was the "Gassner," and a few thousand cells of that type were imported and sold at a very high price.

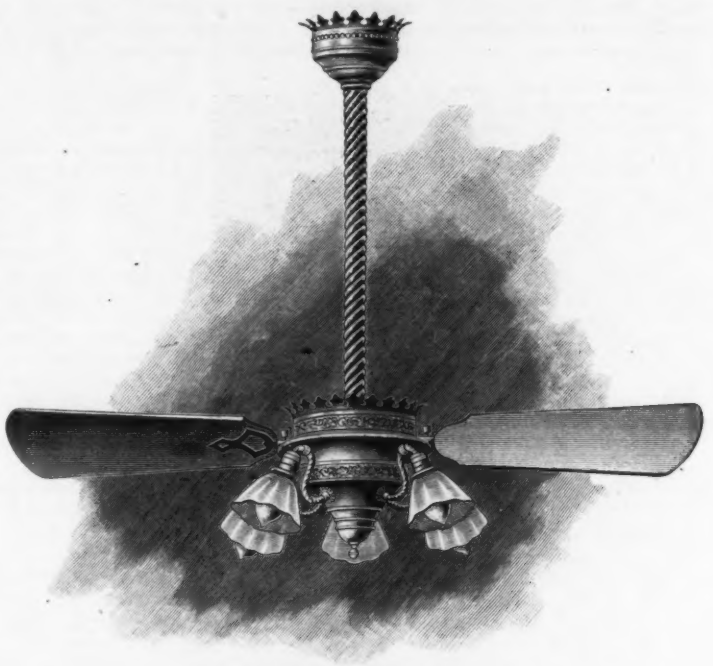
Messrs. J. H. Bunnell & Co., 76 Cortlandt Street, New York, with their usual foresight, believing that an efficient dry cell would find a ready sale promptly put one on the market, and they claim to be the pioneers in bringing out the first practical, American-made dry battery. The excellence of this battery, together with the able manner in which it was handled, soon made it an acknowledged commercial success, and, notwithstanding the fact that it was handicapped with a heavy royalty the battery of this firm, on account of its acknowledged excellence, has continued to hold a leading place, and its sales are estimated to have reached about a million cells.

Messrs. J. H. Bunnell & Co. have recently extended and improved the facilities for making their "Mascot" dry cells, the quality of which is guaranteed to be the best for strength, durability and recuperating powers. The low price at which they are now being quoted would seem to justify the claim that the "Mascot" dry cell will largely supersede wet cells for all open circuit work.

Combination Fans and Electroliers.

There is no surer sign of the advance of Spring than the appearance of new designs of fans and fan-motors upon the market. This season seems to be especially distinguished by the variety and beauty of these designs. Among the handsomest that have appeared is that illustrated herewith, showing a combined ceiling fan and electrolier, made by the Diehl Manufacturing Company, Elizabethport, N. J.

The experience of many seasons in the design and construction of fan-motors has enabled the Diehl Company to standardize its product and to reach a high grade of efficiency and durability in the same. These fans are of the tried-and-proven type, which has shown good results for a long time. Their novelty is in their artistic design and appearance.

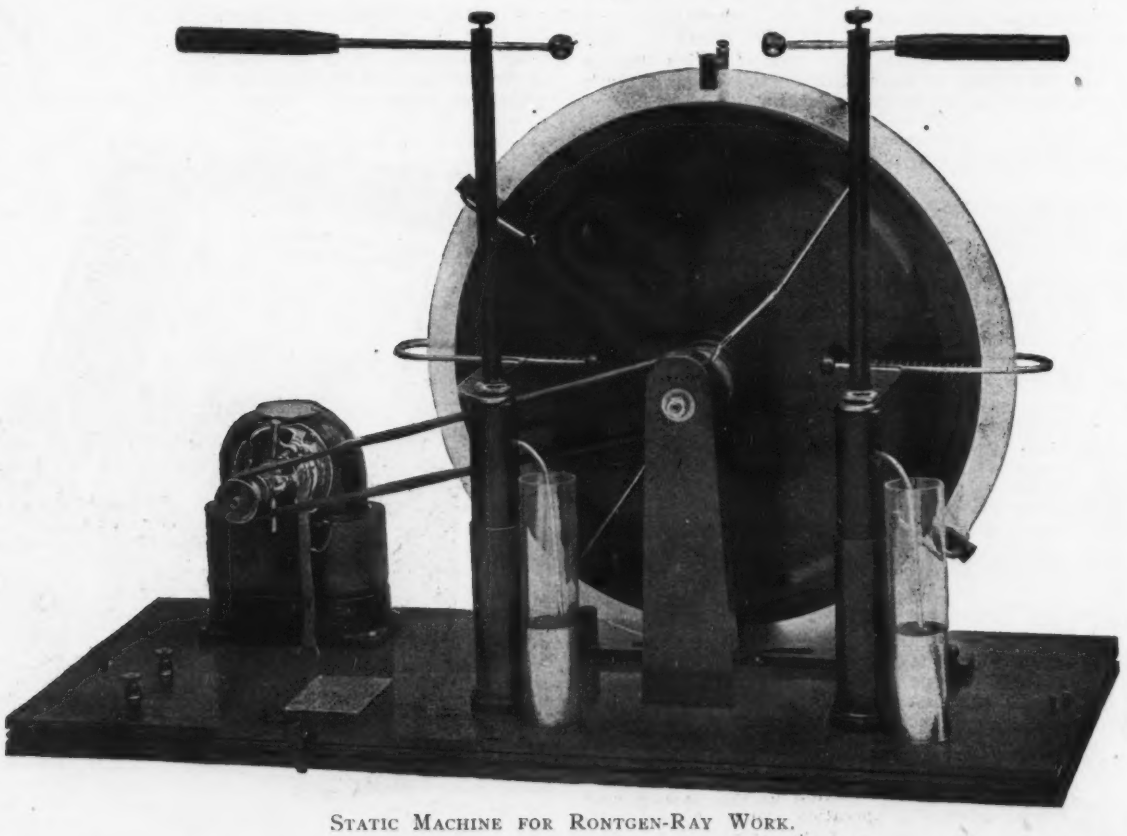


ELECTROLIER FAN.

The electrolier fan is so wired that the lights and motor may be operated from different circuits if desired. In Winter the fan blades may be removed, leaving a very handsome electrolier fixture. Its finish is in solid-cast brass to meet the demand of high-class restaurants, etc., but the finish may be altered to suit any decorations of ceilings under which they are used.

A Static Machine for Rontgen-Ray Work.

It has now come to be very well understood that for the production of Rontgen-rays a static machine is in some respects superior to an induction coil. The difficulties surrounding the proper operation of an induction coil are many, as those who have handled such apparatus well know. The desideratum in static machines has been one that will combine with high potential and considerable energy of current a great rapidity of discharge. It has seemed that rapidity of discharge was a necessity for highly penetrative rays and that in many cases machines giving discharges of slower frequency showed excellent results upon the hand or thinner portion of the body, but did not generate rays which could penetrate deeply or which were useful for general practical work. The limitations of glass plate machines are apparent. It is impossible with them to secure high speeds, and the only way in which sufficient accumulation of charge for the rapid discharge of condensers could be obtained was by the cumbersome increase of the number of plates. This has led to the use of hard rubber plates only large enough to produce the necessary length of discharge and to run them at very high speed, increasing the accumulation in this way. The

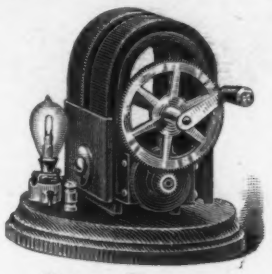


STATIC MACHINE FOR RONTGEN-RAY WORK.

machine which is illustrated herewith is a recent product of the L. E. Knott Apparatus Company, Boston, Mass. It is arranged either to be driven by hand or by an alternating or direct current motor, which may be placed on the inside of the case which shields the whole from dust and moisture. The difficulty of reversal of polarity which has been charged to some static machines has been overcome in this particular form and its capacity as a generator of Rontgen rays is very highly spoken of.

A Handy Small Dynamo.

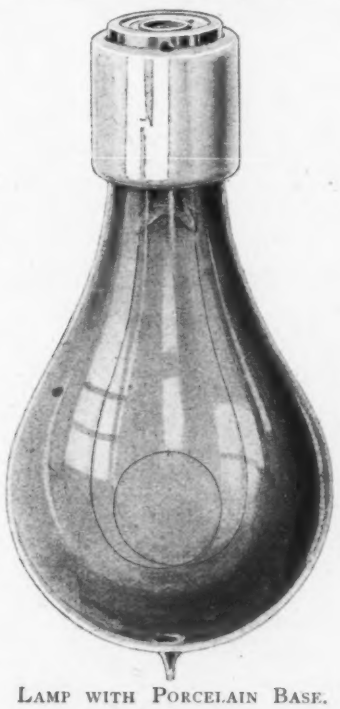
The little machine shown herewith is being put upon the market by the Bubier Publishing Company, Lynn., Mass., and is designed for several practical applications as well as for demonstrations of the action and illustration of the principle of the dynamo electric machine.



SMALL DYNAMO.

We are informed that it will generate sufficient current to brilliantly light two 1-cp incandescent lamps, and that it can as well be used as a medical machine for family practice, being provided with foot and sponge electrodes when these are desired.

This little dynamo weighs about five pounds and stands about six inches high, and in addition to the useful applications of the same above enumerated, it can be used by electricians as a testing machine. It is so simple in its construction that it can be operated with much ease. A glance at the illustration will bear evidence of this fact.



LAMP WITH PORCELAIN BASE.

A Porcelain Lamp Base.

The increasing use of 220-volt distribution systems for incandescent lighting has presented some problems in lamp base insulation which are by no means easy of solution. The ordinary brass base cemented to the lamp with plaster of Paris has proved very undesirable for this purpose in street railway cars, outdoor sign work and in mills and cellars where there is much dampness or corrosive fumes.

To meet the demand for a lamp base which would obviate as far as possible these difficulties, the Bryant Electric Company, Bridgeport, Conn., has placed upon the market the porcelain base here illustrated. The finest grade of glazed porcelain is used, the contact rings being cemented in such a way that their union with the porcelain is very rigid. The peculiar advantages that this highly insulating substance possesses for this purpose are obvious. The readiness with which it can be cleaned is no small addition to its other valuable qualities. The bases have not been placed upon the market for general sale, but are made only for lamp manufacturers.

A Steam Motor.

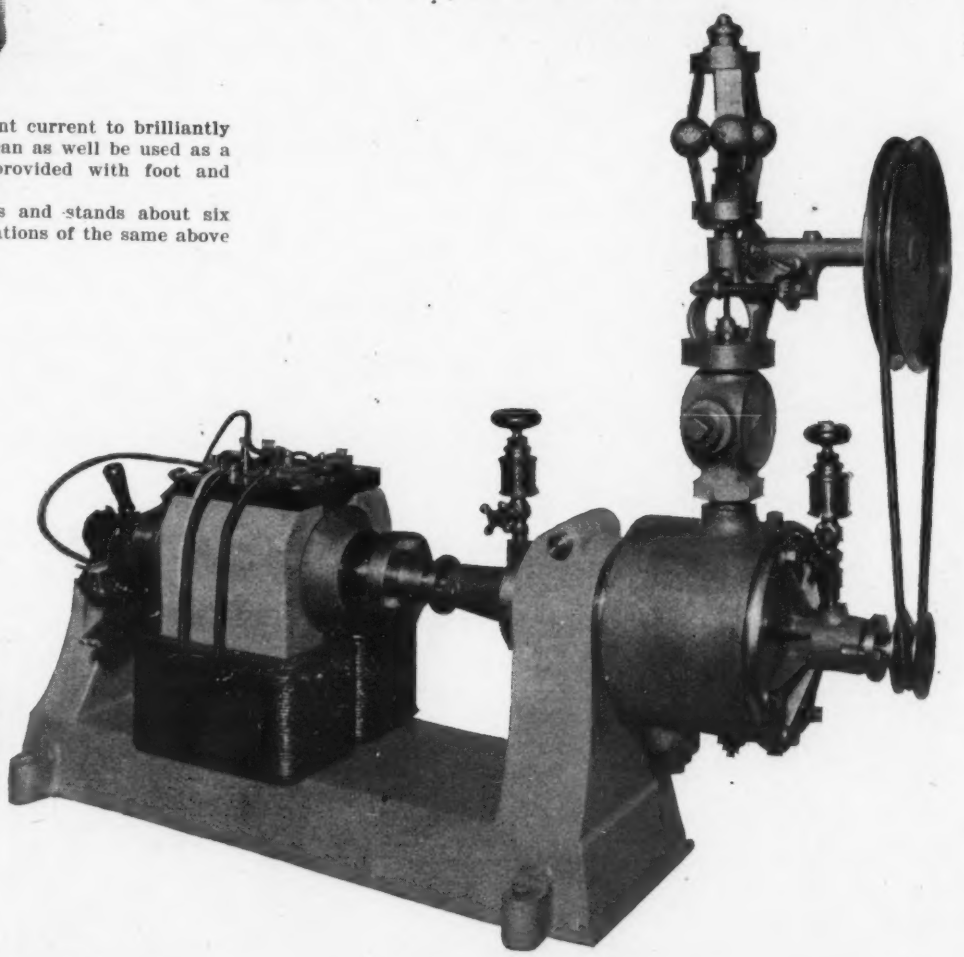
The demand for a high-speed steam motor differing from the ordinary types of engines, for direct connection to dynamos and for other purposes, has resulted in the design of the machine here illustrated, which is built by James T. Halsey, Philadelphia, Pa.

This motor is of the multiple-cylinder type, having four cylinders on a crank, the cylinders acting simultaneously on the crank-pin so that the wear can be considerable without making a noise or thump. The wearing surfaces are all steam balanced, there being no connecting rods or valve gear to adjust, and no keys or adjusting bolts, so that an engine will run for a long period without attention other than filling the oil cups.

One of the first engines built has made the remarkable continuous run of fifteen months, night and day, and is still running at 2000 revolutions per minute directly connected to a Sturtevant No. 5 fan.

In another case the engine ran for eight months before repairs were required, which were only the renewal of bushings on the crank-pin and main bearings. The requirement demanded for this engine was continuous running, so that when the repairs were needed the manufacturers replaced the engine by another. The design of the machine enables this to be successfully accomplished, as is shown by the illustration. The bed-plate or bracket is independent of the engine proper, while at the same time the alignment of the engine shaft is not disturbed when a change is made.

As to economy of steam, the engine is made in two styles, automatic and throttling. The automatic gives a degree of expansion cutting off at from 0 to ⅝ like any single valve engine.



STEAM MOTOR.

On account of their high rotative speed these machines are capable of running with a small clearance, consequently with great economy. The speed regulation is between 2 and 3 per cent. for the automatics, the principle of the governor being the centrifugal force of weight. The throttling engines are governed by the ordinary throttle governor that is common in the market. In cases of high steam pressure, the engines are made compound or quadruple expansion.

Automatic Circuit Breakers.

The Ward Leonard Electric Company, Hoboken, N. J., has recently placed upon the market a new automatic circuit breaker, which is the invention of Mr. H. Ward Leonard, and which possesses many points of exceptional merit.

This automatic circuit breaker opens automatically whenever the line voltage falls abnormally low, and it also automatically opens when the current becomes abnormally large.

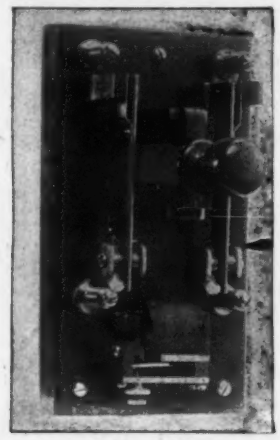
The current may fall to zero, and even go in reverse direction, as in elevator practice, and still the switch will not open so long as the E. M. F. is normal. This is a feature of great value, and this automatic circuit breaker is entirely unique in this respect.

If, however, the E. M. F. falls too low, showing an improper state of the supply circuit, such as a shutdown at the station or an open

circuit in the supply line, the circuit breaker will instantly and automatically open.

The Ward Leonard circuit breaker is double poled, and is provided with a carbon break on both poles. It is entirely independent of position, that is, it will operate perfectly and with constant results in any position. It is also independent of shocks or jars and independent of changes of temperature. The overload device can be set readily by the operator to cause the switch to open at any desired amperes, and a scale, showing the amperes, is provided for this purpose.

This automatic switch, as will be observed by the illustration here-



Automatic Circuit Breaker.

with, is quite neat in design and very compact. Its features are entirely new, and while protecting all the points covered by the forms now on the market, it is claimed by the manufacturer to have many desirable features not possessed by any other switch.

A small push button enables the operator to work the switch by hand, to open the circuit whenever desired.

It is claimed by the Ward Leonard Company that this switch is the only one which is adapted to operate perfectly in connection with electric elevators and incandescent electric lights, where the requirement is that the switch should remain closed, even when there is no current flowing in the circuit, so long as the E. M. F. is normal, and yet should open whenever the current becomes excessively large and whenever the supply E. M. F. fails.

A Novel Electric Motor.

Probably one of the most notable recent developments of electric power is the general application of slow-speed motors to operate individual machines. A slow-speed motor, or in fact any dynamo machine must, however, be provided with either a comparatively large field or armature. The first plan is met in practice by the multipolar field design; the second by external armatures, where it is desired to get the minimum speed from a certain weight and bulk of material. Large external rotating armatures have some objectionable features which, however, entirely disappear if the armature is made a fixed element, and the field magnets are rotated. It is on these lines that the machine here shown is being built by the Imperial Electric Company, 140 Washington Street, New York City.

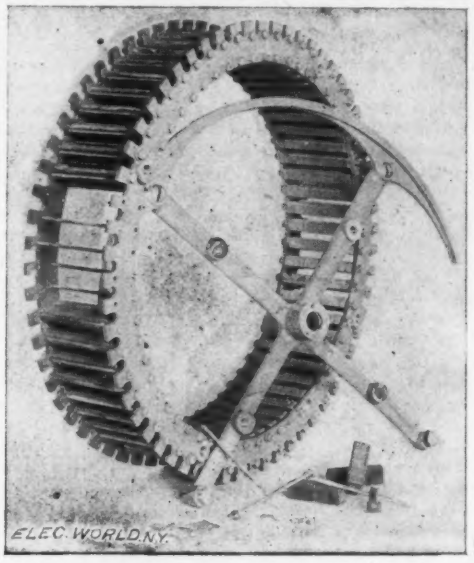
The reversal of the usual methods in the construction and operation of this machine has introduced a number of excellent features whether the machine is to be used as a dynamo or motor, although it is especially built at present for the latter purpose. Not only has the object been to reduce the speed to the lowest practical and efficient limits, but particular attention has been given to minimize breakdowns and facilitate repairs.

The motor, if taken from its base in which form it is entirely self-contained, resembles a short cylinder standing on its circumference. In its complete form the height of the machine is 15 inches over all, and the base area measures 14 by 9 inches. The capacity of the motor is from ¼ to ½ hp, according to the speed for which it is wound. For either capacity the motor is built in only one size, weighing complete, with base, 90 pounds, and the speed is from 500 to 700 r. p. m.

The armature is built up of two annular brass rings kept three inches apart by a series of circumferentially placed laminated iron tooth blocks, which extend from the inner to the outer circumference of the brass rings, and are securely clamped between them by bolt pins extending through from plate to plate. The laminations of the blocks are so placed that they form a series of regular teeth projections on each side of each individual block. Each armature coil is separately wound on an oblong spool and slipped on a separate laminated iron core, which also has the teeth arranged on its side to co-act with those in the tooth blocks, so that each coil with its core can be easily pushed in between two tooth blocks and held there by the dove-tailing of the projecting laminations, which are about No. 22 soft Swedish iron.

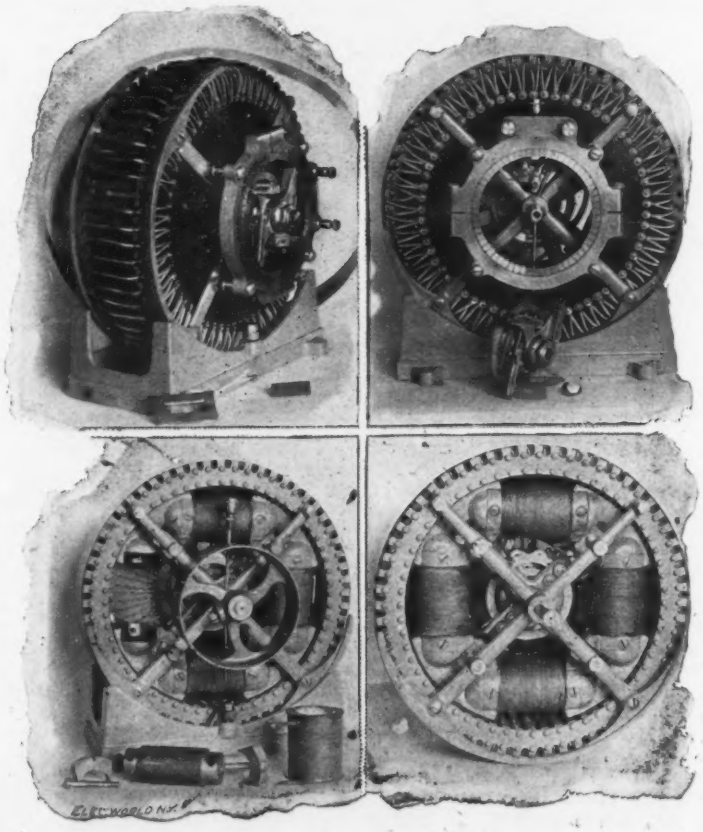
Each of the sixty armature coils is entirely distinct and can be easily inserted or removed from any part of the armature. These coils do not project beyond the inner or outer circumference of the annular cylinder formed by the tooth cores; in fact, when the armature is complete it is purely a tooth Gramme ring with separable coil cores. The essential difference, however, consists in the fact that the active circumference is reversed, being in this case the inner. The outside of the armature is surrounded by a thin iron ring which completely protects the exterior side of the coils. By this construction of the armature, the difficult balancing and centrifugal strains, necessitating well fixed conductor and binding wires, are eliminated. The method of inserting the armature provides a thorough ventilation, which is due not only to the large inner and outer surface of the armature ring, but also to the open spaces between the coils.

Terminals from each armature coil are brought to screw connection contacts on an insulating disk-plate attached to one side of the arma-



Stationary Armature Core.

ture. From each of these connections a wire on the back of the insulating plate is brought to its respective commutator segment. Each coil in case of accident can be easily removed by simply unscrewing the contact terminals, pulling out the core and coil and inserting a new set. This can be done even while the machine is in operation by short-circuiting across the terminals. It is only necessary to carry a few spare coils to be able to meet ordinary emergencies. The commutator is stationary, consisting of a number of keystone rolled copper segments



Imperial Electric Motor Assembled.

which are insulated from each other and from the external clamping-ring by ample mica insulation. The segments are placed in position and secured together by clamps, making a circular concave internal contact surface. The commutator is fastened by suitable screws through the holding clamps to a four-arm bracket, the outer extremity of each arm being fastened to the brass ring on the side of the armature cores. A bearing chamber is placed at the intersection of the arms and is fitted with an adjustable phosphor-bronze self-oiling bearing. At the oppo-

site side of the armature a similar bracket is fastened. Each of these brackets is fitted with a curved slide which fits in the base slides whereby the armature may be rocked and adjusted through a large arc, permitting easy access to any of the lower armature coils. The rotating field is of the consequent pole multipolar type, and is built of highly magnetic steel castings. When complete it has a square appearance, each side being formed by one of the four fixed field coils and its core, which terminates in a rounded pole piece. There is no break in the magnetic field circuit from pole to pole. The air gap between the polar surface and the armature is exceedingly small, and it is to be noted that the entire magnetic circuit through each pair of poles and armature is reduced to a minimum. The heavy and evenly balanced construction of the field magnets causes them to act as a fly-wheel. The entire field magnet is supported by a single brass spider on a shaft which extends centrally through both bearings, one end intended for driving purposes and the other being fitted with four rotating brushes mounted in an adjustable holder and directed radially against the contact surface of the commutator by springs. On the inside of the bracket, fastened to the commutator end, are two fixed concentric contact rings forming terminals of the field windings; on the other side of the bracket, fastened to the brush-holder, are two similar rotating rings, forming the brush terminals from the armature, and between this and the field contact rings are two carbon brushes pressed by springs against each contact ring, thereby connecting the inner and outer rings together. These brushes form the terminals of the machine, which, as will be seen, is shunt connected. The entire brush-holder and rotating contact rings are easily removable by simply removing a single bolt, and can be adjusted to change the diameter of the commutator for reversal and other purposes. The operation of the commutating devices is claimed to be entirely sparkless under wide ranges of load.

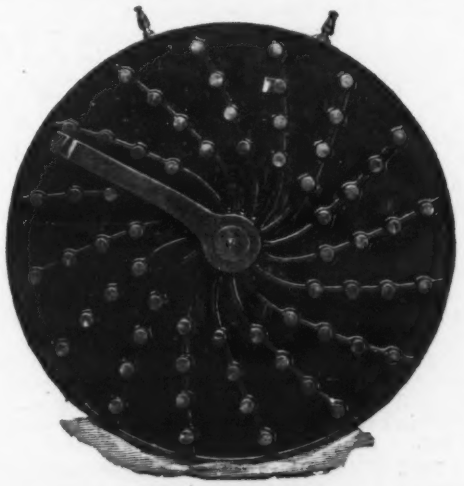
At present this motor is being quite extensively applied to the direct operation of Linotype machines. Mr. J. W. Eskholme, the president of the Company, who is the designer of this novel motor, is now working on larger sizes which also will embody some new features. He also intends to bring out shortly a dynamo built on similar principles.

New Types of Enamel Rheostats.

It is well-known that enamel rheostats are the most compact for a given capacity, are entirely fire-proof (meeting all demands of the insurance requirements), and have high insulation. As heretofore constructed enamel rheostats have usually had all the resistance in one envelope of enamel attached to a cast-iron plate, thereby making all the imbedded resistance a single unit which, if it failed in any part, destroyed the value of the entire plate. Also because of this method of construction purchasers have been compelled to select for their needs from the standards established by manufacturers, or pay an extra price and be subject to considerable delay in getting supplied. As is well-known, no two dynamo manufacturers make machines of similar capacity which have the same field resistance, and all manufacturers make changes continually in the windings and proportions of the dynamos they produce; therefore, without an infinite number of sizes no manufacturer can carry in stock rheostats that supply just the external resistance required in each case.

In an endeavor to overcome the objections to the present market product, and at the same time preserve all the advantages of the best that has been produced, the American Electric Heating Corporation, Boston, has ready for market a line of dynamo field rheostats which it is believed will accomplish the desired results.

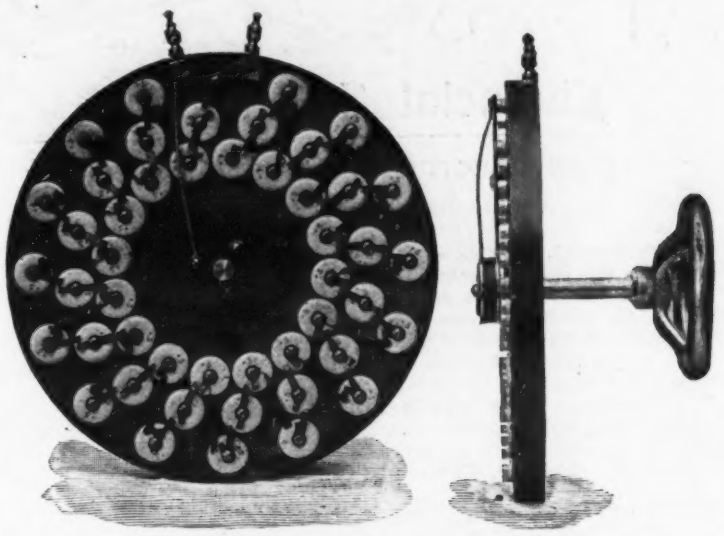
The rheostats consist of circular cast-iron plates, on which are placed



FRONT OF BOARD.

a sufficient number of enamelled steel discs containing resistance to provide the necessary number of divisions and total resistance required. These discs are of uniform size, but vary between wide limits in resistance and ampere capacity.

The cast-iron supporting plate is provided with suitable holes which permit a single bolt to clamp the connections, discs and plate firmly together, and the bolt heads form the contact points over which the usual movable arm rotates. By this method of placing the resistances one or more rows of contacts may be arranged, thereby distributing the resistance over a greater surface of a given size plate than has been the practice where all the resistance is located outside the circle of contact points. In the event of injury to any part of the circuit it would require but a few moments' work of the dynamo tender to locate the fault, remove or cut out the defective part and continue the use of the rheostat instead of having to procure a new rheostat. The possibility of "burn outs" is very slight and cost for repairs nominal. No disc can ever have more than its predetermined load, and the factor of safety allowed is large. Each customer can have exactly the rheostat required for his dynamo. Special rheostats within the limits of sizes made can be furnished at once. By reason of there being but few sizes of plates required to meet all demands, but an almost infinite combination of resistances, no delay need occur in filling orders, for the average rheostat can be assembled in an hour, and it is a simple matter to keep an assortment of resistances complete.



BACK OF BOARD. SIDE VIEW.

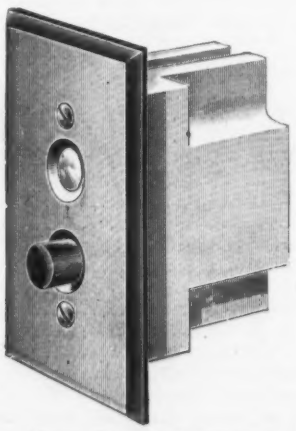
All field rheostats for mounting on back of switchboard are made so that the holes drilled for one will answer for any size, so if it was desired at any time to change from one size to another it would involve no change in the supporting bolts or their location.

Quite an important feature is that if by carelessness an excessive overload should be applied and allowed to remain to the point of causing a "burn out," no serious harm could be done, for at most but two or three of the discs could be injured. The connections are such that the field circuit cannot be opened if the arm fails to make contact.

Field rheostats only are ready for market, but motor starters, regulators and theatre dimmers, embodying the same distinctive features, are under way and will be ready in the near future.

Porcelain Push-Button Switch.

The demand for push-button switches in the highest grade modern installations has led to remarkable development along this line in the past few years. The latest patent of Mr. Norman Marshall, of the Anchor Electric Company, Boston, is an exemplification of the high standard these specialties have attained.



PUSH BUTTON SWITCH.

The switch shown in the illustration is made from one piece of porcelain. No part of its mechanism is in circuit except the contacts and circuit-making blades, which form a make and break knife switch. Wires connected with the switch can be pulled taut after it is in position. The lugs for holding the switch to the wall or pocket are recessed into the back of the face plate.

The action is upon the well-known cam principle, which makes the manipulation of the switch very easy, while at the same time the break is very quick and energetic. All these switches are tested with 20 amperes at 110 volts before shipment.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 15, 1897.

ELECTRICAL STOCKS.—Quietness prevailed in this class of securities, the few changes recorded being fractional. The net result of the week's business shows a gain of ⅛ for General Electric, the sales of which for the week were 4275 shares. Edison Electric Illuminating Company, of New York, is unchanged, as are also Westinghouse common and preferred. Electric Storage Battery lost a fraction in common and preferred.

TELEGRAPH AND TELEPHONES.—American Bell declined 1½ points, but the other telephone securities are unchanged. Western Union closed the week with a net gain of 1⅞, while Postal Telegraph remains practically unchanged. Commercial Cable closed with a gain of 5 points.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	105½	106½
" " " Brooklyn	100	..	97
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	26	26½
Electric Storage, pref	100	28	28½
General Electric	100	34⅞	35
General Electric, pref	100	76	78
Westinghouse Consolidated, com	50	24	25
" " pref	50	51	52

BONDS.

Edison Electric Ill., New York, con. 5s	105	108	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	96	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	222	223
American District Telegraph	100	29	30
American Telegraph & Cable	100	87	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	165	172
Erie Telephone	100	66½	68
New England Telephone	100	102¾	..
Postal Telegraph-Cable	100	96½	98
Western Union Telegraph	100	84¾	85

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18⅛	18¼
Brooklyn Rapid Transit	..	20½	21½
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	71	73
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	42	44
Hestonville	100	51	51½
" pref	..	..	62½
New Orleans Traction	100	6	8
" " pref	100	..	35
North Shore Traction	100	20	22
" " pref	100	79	81
Rochester St. Ry	..	15	18
Steinway Ry	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	71¾	72¼
" " pref	100	91	91½
Worcester Traction	100	20	22
" " pref	100	94	97

BONDS.

Brooklyn Rapid Transit 5s, 1945	100	81⅛	..
Buffalo St. Ry. 1st con. 5s	100	*106	108
Cleveland Elec. Ry. 1st mtge. 5s	100	103	105
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	*102	106
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

ELECTRIC TRACTIONS.—Electric railway securities showed greater strength and activity last week than for some time past, the closing prices being in many instances the highest of the week. Buffalo, Brooklyn City and Columbus Street Railway led in the advances. The disposition of the Brooklyn Bridge Trustees to allow the elevated and surface cars to cross the Bridge is supposed to be the reason for the activity in Brooklyn City stock.

DIVIDEND.—The Edison Electric Illuminating Company, of Brooklyn, has declared a quarterly dividend of 1½ per cent., payable April 15.

NEW ISSUE OF STOCK.—The Massachusetts Gas and Electric Light Commissioners have granted permission to the Edison Electric Illuminating Company of Boston, to issue 5000 shares of new stock, fixing the price at $120 per share.

FINANCIAL OPERATIONS.—The Edison Electric Illuminating Company, of New York, reports gross earnings for February of $212,803.96, an increase of $17,582, as compared with the same month last year, and net earnings $118,007, an increase of $12,573. For the two months ending Feb. 28, the gross earnings were $453,103, an increase of $39,700 over the same months last year; net earnings for the two months, $230,551.13, an increase of $30,261.56.

WESTERN UNION.—A quarterly dividend of 1¼ per cent. has been declared by the Western Union Telegraph Company. The Company reports for the quarter ending March 31 net revenues (estimated) $1,100,000, an increase of $48,285, as compared with the revenue of the corresponding quarter in 1896, leaving a balance, after deducting interest and sinking funds, of $856,641, representing an increase of $48,265. The deficit was $335,320, a decrease of $48,256; surplus, $7,570,721, a decrease of $68,236, as compared with the same quarter last year. For the three-quarters of the fiscal year ending March 31, the net revenues are estimated at $4,232,987, a decrease of $264,793, as compared with the three-quarters of the previous year.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 17, 1897.

ANXIOUS TO HAVE THE UNDERGROUND TROLLEY SYSTEM.—The property owners and business men on Eighth Avenue, south of Fifty-ninth Street, held a meeting on March 10 to protest against the proposed change of route of the underground trolley line to be constructed by the Metropolitan Street Railway Company. They want the trolley system all the way down the avenue.

EXPLOSION OF A MANHOLE.—On the morning of March 10 an explosion took place in two manholes of the Empire City Subway Company, at the corners of Third Avenue and Seventy-sixth and Seventy-seventh Streets. The granite paving blocks near the manhole were blown into the air about ten feet, but did no damage, and the ground at both places was torn up for about twelve feet square around the manhole. The concussion was quite violent and shook the neighborhood for several blocks.

TO CELEBRATE THE ESTABLISHING OF GREATER NEW YORK.—Senator McNulty, of Brooklyn, has introduced a bill in the Legislature at Albany, authorizing the City of New York to acquire lands and erect, furnish and equip buildings thereon for an exhibition of arts, science, manufactures, and products of the soil, mines and sea, to be held during the year 1901 to commemorate the incorporation of the Greater New York. The bill authorizes New York City to issue $2,000,000 in bonds for the expense of the exposition. The Governor, Mayor Strong and several prominent and wealthy citizens are proposed as a Board of Exhibition Commissioners with power and authority in the name of and in behalf of the City of New York to carry out the purposes of the bill.

TO LIGHT THE SUB-TREASURY.—Mayor Strong recently approved the bill prepared for the Legislature providing for the construction by the government of an electrical subway in Wall Street between the Custom House and the Sub-Treasury Building. It is proposed to light the Sub-Treasury Building and also the Assay Office, which adjoins the same, by the current generated in the Custom House, and in order to provide means for doing this, the laying of a subway is necessary. The present subway could not be availed of for this purpose for the reason that under the present law no one except a regularly organized company or association can utilize the existing subways; therefore, it was necessary for the government to secure the passage of a special law in order to enable it to carry out its purpose. The contract for the work will be let as soon as the bill becomes law.

OPPOSITION TO THE UNDERGROUND TROLLEY.—The Board of State Railroad Commissioners met at the rooms of the Chamber of Com-

merce on the morning of March 10 to consider the application of the Metropolitan Street Railway Company to substitute the underground trolley system for the present motive power on the lines in Sixth Avenue, Eighth Avenue and part of Ninth Avenue, and on the Belt Line. Mr. W. H. Page, Jr., on behalf of the Third Avenue Railroad Company, et al., objected to the proposed change and moved to dismiss the application upon various grounds. Mr. William C. Whitney, for the Metropolitan Street Railway Company, intimated that Mr. Page's object was a dilatory one. He stated that his Company was now prepared to spend five or six million dollars and to build two parallel lines to relieve the glut of travel. He stated that work should begin at once if at all. The Company intended to build 2000 feet a day when once started in the work.

MR. O. S. PLATT, president and general manager of The O. S. Platt Manufacturing Company, 88-102 Cannon Street, Bridgeport, Conn., manufacturer of the well-known New England switch and other electrical appliances, made a pleasant call at the office of THE ELECTRICAL WORLD on March 17.

SURFACE CARS ON THE BROOKLYN BRIDGE.—The Bridge Trustees have under consideration the subject of remuneration from the railway companies for the privilege of running their cars across the Bridge. It is understood that the companies are willing to pay a certain percentage of their Bridge receipts, and that this will not be less than the full Bridge fare.

PROMINENT VISITORS IN NEW YORK CITY.—Among the out-of-town visitors registered at the office of the National Electric Light Association, 136 Liberty Street, for the week ending March 12, are the following named gentlemen: C. S. Knight, Fort Wayne, Ind.; D. D. Dickey, Pittsburg, Pa.; W. C. Balida, Utica, N. Y.; J. Wilson, Boston, Mass.; Samuel Insull, Chicago; J. J. Burleigh, Camden, N. J.; H. Brooks, Boston, Mass.; E. F. Phillips, Providence, R. I., and H. C. Adams, Jr., Pawtucket, R. I.

ELECTRICAL EXHIBITS AT THE SPORTSMEN'S EXPOSITION, at present being held at the Madison Square Garden, seem to be entirely absent, except in one instance. This is the exhibit of the Portable Electric Boat Propeller Company, which shows a small portable electric motor and propeller that can be attached to the rudder post of any ordinary rowboat. Current for the motor is supplied by a set of Crowdus batteries in two hermetically sealed boxes. This portable electric motive power outfit for boats has been previously described in THE ELECTRICAL WORLD. At the exposition it is attracting particular attention on account of its portability, light weight and the peculiar advantages that it presents to all who have occasion to use small boats. Mr. Frank S. Allen is in charge of the exhibit, and the offices of the company are at 136 Liberty Street.

THE ELECTRIC CARRIAGE & WAGON COMPANY will shortly send out from its station, at 140 West Thirty-ninth Street, about a dozen electrically propelled hansom cabs. This company operates the Morris and Salom system of electric motor vehicles. The cabs, which are to be used in New York, are particularly elegant in general appearance, and are a most excellent example of the carriage builder's art in every respect, seating two persons and driver. The motive power is furnished by a set of forty-four storage batteries, placed in a box under the driver's seat, at the back of the cab proper, and the front driving wheels are each individually operated by two Lundell 1½-hp motors. On March 16 the New York Board of Aldermen granted permission to this company to operate its cabs throughout the streets of New York, and the company intends to at once take advantage thereof. The cabs will be put in actual service, and probably worked similarly to ordinary horse-drawn vehicles, charging, perhaps, the same rates.

THE REPRODUCTION OF THE CORBETT-FITZSIMMONS PRIZE FIGHT in this city, by the aid of the ordinary telegraph and various moving figures or moving picture arrangements, seems to have attracted a vast amount of general interest. One New York newspaper, through its direct-connected telegraph lines from the scene of the battle, received almost instantaneous information of the various stages of the encounter, and had an arrangement in front of the building showing a prize ring with the audience about it, the prize ring being occupied by two marionette figures representing the combatants, which were manipulated by the operators immediately above, who were screened from the view of the crowd, numbering thousands, who watched the performance from the street. Upon the receipt of any particular item indicating a change in the battle, the operators at once properly adjusted their marionettes to correspond to the original situation. The exhibition furnished an excellent opportunity for a display of telegraphic speed, and was most novel and effective. At one prominent continuous performance theatre a form of picture projection apparatus is used in place of the marionettes.

NEW ENGLAND NOTES.

BOSTON, MASS., March 16, 1897.

"DURO" TELEPHONE CORD.—Mr. C. H. McEvoy, Lowell, Mass., manufacturer of this specialty, and other telephone specialties, has just issued a neat little catalogue which is bound to command attention.

MR. E. M. CARHART, Providence, R. I., an "old timer" in the electrical business, has recently invented a new car fender, which receives very complimentary mention in a recent issue of *The Providence Journal*.

MR. FRANK W. FOYE, with Messrs. Thomas Smith & Co., Worcester, Mass., made this office a pleasant call this week. This firm is quite well-known to the electrical trade for its armature discs and bolt and nut specialties.

THE WEST END STREET RAILWAY COMPANY has petitioned the city government of Cambridge for permission to lay conduits through certain streets, and if it is granted, the West End Company will at once begin the erection of a $400,000 power-house at the foot of Boylston Street.

THE ANCHOR ELECTRIC COMPANY'S New York office, 26 Cortlandt Street, is now under the charge of Mr. F. H. Schlesinger, who is well-known among the electrical fraternity, particularly in the West, and in New York and Philadelphia. Mr. Schlesinger is a young man, but his frank and pleasing manners assure him a kindly welcome always, and he will undoubtedly score some good success with the new and interesting specialties which the Anchor Company has been hatching up during the Winter, and which are now for the first time ready for the market.

THE SWETT & LEWIS COMPANY, Boston, has just issued a very neat catalogue covering its Rontgen-ray manufactures, a list of photographic supplies and including testimonials of its supplies and specialties. The Swett & Lewis Company is receiving some very flattering testimonials as to the quick work of its tubes in connection with a static machine. The Swett & Lewis Company and its predecessors, G. A. Frei & Co., have always advocated the use of a static machine for Rontgen-ray work. It is now making an improved tube especially for large static machines, and have attained very satisfactory results from them.

THE PETTINGELL-ANDREWS COMPANY, Boston, held a special meeting last week, at which important changes were made in its executive staff. Mr. Chas. B. Price, whose position has been that of vice-president and general manager, was elected president of the Company, and Mr. Frank S. Price was elected to the position of secretary. Mr. D. A. Andrews, of course, remains as treasurer of the Company, for which position he possesses executive ability and special qualifications. The elevation of Mr. C. B. Price to the presidency is a deserved compliment and reward for the well-directed energies he has given to the Company and which have contributed in a large measure to its success. Mr. Frank S. Price, brother of C. B., has earned the position of secretary by faithful service with the Company, acquiring an intimate knowledge of the details of the business, which eminently fits him for his new duties. The business of the Pettingell-Andrews Company for the year just closing shows most satisfactory results and the usual increase over preceding years, and with the advent of new ideas and policy the incoming year is expected to show prosperity greatly exceeding that of any year in the history of the Company.

THE BELKNAP MOTOR COMPANY, Portland, Me., notwithstanding the long-continued business depression, has been fortunate all along in keeping its plant very busy—a statement amply substantiated by the fact that during the past three years its plant has been almost, if not quite, doubled in space and manufacturing facilities. Its motor and dynamo manufactures have always commanded liberal recognition, and it can refer to a decidedly creditable list of installations, particularly in New England, and quite a number outside of this territory. Isolated plants have been its specialty, as have also been marine installations, among which may be mentioned the handsome steamers "Bay State" and "Portland" of the Boston line, installed a little over a year ago; "Cottage City" and "Manhattan" of the New York line, installed last Summer, and the "St. Croix" and "State of Maine" of the International line, now in process of installation. The dynamos in connection with these marine installations are all direct connected. Elevator work is also a specialty of the company, in which it has done a profitable business. Some important features have been added to the smaller motors of this company, prominent among which are: An improved rheostat, which is mounted directly on the top of the field magnets. The lever arm of the rheostat is automatically released when the circuit is broken. Another feature is the brush holder with the retaining spring, both of which elements are extremely simple and effective. Mr. George W. Brown, general manager of the company, has been indefatigable in his efforts to contribute to its prosperity, and regards the business outlook as very encouraging indeed. Mr. A. B. Field, 154 Congress Street, is the Boston representative of the company.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, PA., March 15, 1897.

MESSRS. GARRETT MILLER & CO., manufacturers of electrical supplies, Wilmington, Del., have recently issued a very handsome catalogue of 196 pages, containing several hundred illustrations. This catalogue is a most useful one as a book of reference for parties wishing to order anything in the electrical line, and it will be mailed free to interested parties on application.

MESSRS. KREISS & CO., Reading, Pa., have recently placed in Paris an order for an ice machine for a 65-ton plant to be constructed entirely by American builders. They are the first ice machine builders who have entered European territory. All the coil work and ice cans, engine and compressor will make about fifteen car loads. The ice machine is of the consolidated type.

THE FERRACUTE MACHINE COMPANY.—The factory of the Ferracute Machine Company, which is located at Bridgeton, N. J., is kept very busy in order to keep pace with the rapidly increasing demand for its machines. The manufactures of this Company include presses, dies and sheet metal machinery, and among the principal lines of business

using the tools produced by this Company are nearly all of the electrical manufacturers, bicycle manufacturers, tinware and hardware manufacturers, etc. The Company is also building coining machinery, and has now orders for a number of coin presses and dies. Among the large presses recently constructed is one ready for shipment to Budapest, Hungary, weighing about 16,000 pounds; another press with indicating attachment is to be shipped to the Emerson Electric Manufacturing Company, St. Louis, Mo., and several other presses are ready to be forwarded to England, France, Germany, China, etc. The Ferracute Machine Company has built up a large trade along these lines, and is now very busy with orders for two or three months ahead. The Company is constantly introducing new lines of machinery for electrical work, and to meet increasing demands it is now extending its facilities in the erection of a new shop. The handsome catalogue of this concern describes about 300 different styles of presses, and this, together with a special circular describing electrical machinery, will be mailed to interested parties on application.

Buffalo and Niagara Falls Notes.

Buffalo, N. Y., March 15, 1897.

CHEAP TELEPHONE SERVICE.—The Wilhelm Telephone Manufacturing Company, Buffalo, has tendered the City of Toronto telephone service at $32.50 a year for business houses and $18.50 a year for residences.

NEW NIAGARA POWER USER.—The Hygeia Ice & Refrigerator Company, Niagara Falls, will use Niagara power. This Company has been incorporated to manufacture ice and carry on a general refrigerating and cold-storage business and to manufacture aerated waters.

BUFFALO WATER DEPARTMENT ELECTRIC PLANT.—At the meeting of the Buffalo Water Department there was a consideration of bids for electric light plants. It appeared that there was only $4000 in the fund available, and so it was resolved to reject all bids and readvertise.

LOCKPORT ELECTRIC LIGHTING PLANT.—The Common Council of Lockport has voted to make another effort to secure a municipal lighting plant. The city attorney was directed to draft a bill providing for a $50,000 plant. The Council rejected the three years' contract bid of the Lockport Gas & Electric Light Company, which charged $90 per arc light, and directed the Mayor to enter into a contract with it for one year, at the present rate of $72 per light.

BUFFALO TRACTION COMPANY.—Consents have been obtained from property-owners in streets covering fifteen miles of proposed route of the Buffalo Traction Company's new electric road. It has the right of way covering sixty-five miles of streets in the City of Buffalo in its franchise, and it proposes to construct thirty miles of road this year. The site for the new power-house has not been definitely selected, but the Company intends to use Niagara power for operating the cars.

Pittsburg Notes.

Pittsburg, Pa., March 13, 1897.

NEW ELECTRIC RAILWAY.—A charter was issued on March 11 at Harrisburg to the Monongahela Valley Traction Company for an electric road in Washington County between Monongahela City and West Brownsville. The proposed line will be about eight miles long, and the company is capitalized at $200,000.

TAX ON RECEIPTS.—The Allegheny Select Council on March 12, at a special meeting, considered the ordinance relating to the 2 per cent. tax on the gross receipts of the North Side Traction Company. This ordinance was referred to in a previous issue of The Electrical World. On the first vote it failed to pass, but afterwards the vote was reconsidered and the measure was finally passed unanimously.

LARGE UNITS.—One of the 1500-kw direct-connected two-phase alternators now being constructed by the Westinghouse Electric & Manufacturing Company for the Allegheny County Light Company, is in position in the latter company's Twelfth Street Station, and will be ready for operation as soon as steam and exhaust connections are made. It is coupled direct to a vertical cross compound marine type engine built by the Westinghouse Machine Company. A second similar set is being assembled on its foundation and a third and fourth are being built for immediate delivery. These four units are designed to supply all the alternating current output of the plant and will replace a large number of smaller dynamos and engines. They will deliver current at 2400 volts and a frequency of 7200.

Cleveland Notes.

Cleveland, O., March 13, 1897.

LIGHTING FRANCHISE GRANTED.—At a meeting of the Council March 12, a franchise for lighting Medina by electricity was granted to Osro Sanders. Medina capital will be largely used in the enterprise. The Council made no agreement to light the town, so that the Company will have to depend on private users for a revenue.

REMOVAL OF WORKS.—The Brush Electric Company, who at one time gave employment to about twenty-five hundred hands in this city, in the manufacture of arc apparatus, is now entirely closed down. It is expected that the large buildings which it vacated will be rented to a number of small manufacturing concerns.

MR. D. THOMSON, brother of Prof. Elihu Thomson, made a short stop here and called on friends while on his way from Ithaca, N. Y., to Hannibal, Mo. Mr. Thomson has purchased the property of the Hannibal Railway Company. He will rebuild and equip the old road and make considerable extensions to the present mileage.

STREET RAILROAD FOR SALE.—May 3 is the day fixed for the sale of the East Liverpool & Wellsville Railway, East Liverpool, O., under foreclosure of the mortgage held by the Cleveland Savings & Trust Company. The Court has rendered judgment in favor of the Trust Company for $288,439.27, and ordered the property advertised for sale.

A CHANGE OF REPRESENTATIVES.—The position of sales agent for the Westinghouse Electric & Manufacturing Company in this territory recently made vacant by the resignation of Mr. J. A. Rutherford, is now filled by Mr. C. S. Powell. Mr. Rutherford has accepted a position as general sales agent for the Steel Motor Company, Johnstown, Pa.

NEW TELEPHONE SYSTEM.—The Home Telephone Company, Cleveland, O., is now in operation with about one thousand telephones, and the Company expects to treble this number during the year. The high rates charged by the Bell Telephone Company will enable the new company to get firmly established in the field. The Home Company's rates are $42 and $36. Henry George, Jr., is president of the company, and P. H. Adams, general manager.

NEW INTERURBAN ROADS.—As an electric street railway centre, Cleveland keeps well in the lead of most of the cities of the country. In addition to its several hundred miles of well-equipped city roads, it will within the next two years have communication by means of rapid transit electric roads with almost all towns within a radius of fifty miles. The Cleveland & Chagrin Falls Electric Railway, twenty miles long, will be ready to commence running by the middle of May. The Company will start by operating five 42-foot cars, mounted on double trucks, each car to be equipped with four 50-hp motors. The power-house is located at Chagrin Falls. Another interurban road to connect this city with Lorain is The Lorain & Cleveland Railway. It will be twenty-six miles long and cars will travel at high speed. Most of the contracts are already placed, and the road is to be in operation some time this Summer. The tracks will skirt the lake shore the entire distance, part of the route being over private right of way. A handsome brick power-house and barns, 112 ft. x 113 ft. has been constructed at a point five miles east of Lorain. The generating plant will consist of four 300-hp Cooper-Corliss compound condensing engines, direct coupled to three 400-kw Siemens & Halske generators. The road will be of the latest and best construction throughout, and will be known as the "Shore Line." Messrs. E. P. Roberts & Co., Cleveland, O., are the engineers.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., March 15, 1897.

TO BE PUBLISHED OFTENER.—Following the publication of the April number, Electrical Engineering will thereafter be published semi-monthly, instead of monthly, as now.

THE JENNEY COMPANY'S PLANT BURNED.—The plant of the Jenney Electric Motor Company, Indianapolis, Ind., was destroyed by fire on March 13. The loss is stated to be about $80,000 and the insurance $35,000.

MR. G. G. LUTHY, of the Royal Electric Company, Peoria, Ill., was a welcome visitor at the Chicago office of The Electrical World a few days ago. He reports a very decided improvement in business since Jan. 1, and is very much encouraged in the future outlook.

ELECTRICAL VEHICLES.—Mr. C. E. Corrigan, of the American Electric Vehicle Company, Chicago, is finding plenty to do these days. The self-propelling vehicles manufactured by this Company are attracting considerable attention, and there is every prospect that the business will grow to large proportions. The Company is now starting up a very fine and completely equipped factory in South Chicago, Ill., to manufacture its handsome and attractive electric vehicles.

A NEW JOURNAL.—"The Telephone" is the title of a new monthly paper hailing from Chicago. The new journal will devote its energies to the upbuilding of the independent telephone interests, and the first number contains reading matter of much interest to telephone men. The editorial page is bright and lively. The headquarters of "The Telephone" are at No. 174 South Clinton Street, Chicago, and its proprietors are Messrs. James E. Keelyn, William R. Mackrille and Kempster B. Miller, Mr. Mackrille being the editor.

MR. E. L. FRENCH, who is well-known to the telephone trade, through his connection as electrical engineer and superintendent of the Missouri Telephone Manufacturing Company, St. Louis, has resigned his position with that Company to accept one with the American Electric Telephone Company, which has recently opened an office in Chicago. Mr. French's extensive experience and knowledge of the telephone business will no doubt prove to be a valuable addition to the American Company's resources, and socially Mr. French is one of the best men to meet. His large circle of friends unite in wishing him a large measure of success in his new position.

THE CHICAGO SCHOOL OF ELECTRICITY.—The committee appointed by the Chicago Electrical Association at the request of the Chicago School of Electricity to investigate and report upon the course of study of that institution, has fulfilled its purpose and made its report, which is in every way favorable to the school. The committee, which consisted of Messrs. W. Clyde Jones, Albert Scheible and E. J. Swar-

tout, reports that it fails to find any statements on the part of those in charge of the institution which would mislead any one into taking the school to be a short cut to a full knowledge of electrical engineering; nor does it find that the school claims to do any more than it is actually doing.

THE AMERICAN ELECTRIC TELEPHONE COMPANY will probably take a new suite of offices in order to enable it to transact its rapidly increasing business with greater facility. The general offices and factory of the Company are at the present time located at 171-173 South Canal Street, Chicago. The Kokomo factory is still kept in operation, and will be continued as a branch, the main factory being at Chicago. Mr. P. C. Burns, president of the Company, has established his headquarters at the Chicago office and Mr. Paul W. Bossart, who will become secretary of the Company under the new arrangements, will also have his headquarters at the Chicago office. In its new quarters the Company will probably maintain an exhibition of a full line of its telephone apparatus, and prospective customers will thus be enabled to test the instruments practically. Mr. H. C. Dodge, who was recently manager of the Standard Telephone Company, Madison, Wis., has become associated with the American Company as general manager, and Mr. E. L. French, who was formerly connected with the Missouri Telephone Manufacturing Company, St. Louis, has accepted a position on the electrical staff.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, March 3, 1897.

INSTITUTION OF ELECTRICAL ENGINEERS.—Last week an extremely short paper was read before the Institution of Electrical Engineers by Mr. E. Wilson, assistant to Dr. John Hopkinson at Siemen's Laboratory, King's College, on "The Relative Size, Weight and Price of Dynamo Electric Machines." The main object of the paper was to explain a large number of curves which Mr. Wilson had plotted, and in which he introduced the term "mass factor," the mass factor of a machine being equal to its output in watts divided by its revolutions per minute. Mr. Wilson appears to have taken a large number of catalogues of our leading dynamo builders, and from this reliable source to have plotted, first of all the weights of the machines as ordinates against their "mass factors" as abscissae, repeating the process with regard to price and "mass factor." The chief point of interest was that the curves conclusively showed that from these points of view the machines of our leading makers are all much the same. The discussion was as brief as the paper, and no remarks of importance were elicited.

CHANGING OVER FROM LOW TO HIGH PRESSURE ON THE EDINBURGH MAINS.—The work of transferring the low pressure three-wire system at Edinburgh to a high pressure two-wire system is progressing rapidly, and already about half the lamp connections on the continuous current system are transferred. On the three-wire system the house lamps are supplied at 110 volts and are connected to copper strip mains between positive of negative and inner conductors. To transfer these lamps to a 220-volt system it is necessary to alter a considerable number of connections to each house, so that the work requires considerable care. When transferred the two outer conductors form one new conductor, and the inner conductor forms the other new conductor, and it is necessary to alter the connections so that meters, motors, arc lamps, etc., receive current from the new connection in the right direction. It is also necessary, of course, to exchange the 110-volt lamps for 220-volt lamps, these latter being sold to the consumers by the corporation at less than cost price, viz., 6d. per lamp. A considerable amount of the street lighting in Edinburgh is done by means of arc lamps arranged either two or four in series on the low pressure continuous current mains. Wherever a section of the mains is transferred to the high pressure system, it is necessary to alter the street lamp connections. Thus, instead of four in series on the outer conductors, there will be four in series between the outer and inner. On the 100 volts between outer and inner it is found necessary to substitute, perhaps temporarily, two 100-volt Jandus-enclosed arc lamps in order to take the full 220-voltage with only two lamps in series. The Jandus lamps which I saw burning in the streets work very satisfactorily and seemed to give excellent illumination.

ELECTRIC TRAMWAYS v. STEAM RAILWAYS.—An interesting dispute has arisen between the Dublin, Wicklow & Wexford Railway Company and the Dublin United Tramways Company, a portion of whose electric system runs parallel to the steam company's line for about five miles. The railway company has complained to the Board of Trade that the electric cars are running at "express" speeds, exceeding those of the railway company's own high-speed expresses, notwithstanding the prohibition contained in the Provisional order under which the Tramways Company works, of speeds higher than eight miles an hour. A Board of Trade Inspector was sent over to Ireland to hold a local inquiry into the matter. It would seem that one of the railway company's engineers played the part of private detective for a long period and spent laborious days upon the cars timing them by means of a stop-watch and taking copious notes. The railway company's chief engineer imperiled his valuable life by occasionally riding upon the footboard of one of the railway company's express locomotives, and alleged that on several occasions the electric cars actually beat his express locomotives, although it is curious that on the days when this strange phenomenon is asserted to have occurred, the private detective's notebook did not reveal any extraordinary occurrence on the cars. The railway company also canvassed the neighborhood to find one just man ready to assert that the cars were a dangerous nuisance and succeeded in unearthing a local doctor, who happened to be a large shareholder in the railway company. This gentleman is in the habit of driving a dogcart at the rate of ten or eleven miles an hour, and was annoyed that he found himself outpaced, so he said, on several occasions, by the tram cars. The ruling of the Board of Trade will be awaited with interest. There can be no doubt that the action was of a decidedly spiteful nature. At the same time the law must be obeyed, and if the cars, as possibly they do, exceed the legal speed of eight miles an hour, the railway company may have in future the satisfaction of seeing its express trains occasionally arrive in Dublin before the electric cars.

General News.

NEW INCORPORATIONS.

THE QUEEN CITY ELECTRIC LIGHT & POWER COMPANY, of Clarksville, Tenn., has been incorporated by John F. Shelton, Julian F. Gracer, B. L. Rice, L. B. Askew and W. E. Beach.

THE GREENBUSH & NASSAU ELECTRIC RAILWAY COMPANY, Greenbush, N. Y., has been organized to operate a surface road from Greenbush to Brainard Station in the town of Nassau.

THE OMAHA CITY ELECTRIC LIGHT WORKS, Omaha, Neb., has been formed by S. L. Wiley, V. G. Lantry and R. Breitung, for the purpose of furnishing electric light and power for private use.

THE SOUTHERN ILLINOIS TELEPHONE COMPANY, Effingham, Ill., has been organized with a capital stock of $50,000. The incorporators are O. T. Kimmel, B. F. Kagay, Jr., and J. O. Partridge, Sr.

THE DELPHOS HOME TELEPHONE COMPANY, Delphos, O., has been incorporated by G. M. Saltzgaber, George M. Kohn, Klem V. Koke, John Van Liew and W. H. Pennell. The capital stock of the new company is $20,000.

THE PLAINVIEW TELEPHONE COMPANY has been organized in Plainview, Minn., with a capital stock of $5000. The object of the company is to build a telephone system connecting Plainview with the other towns in Wabasha County.

THE NEW YORK & NORTH SHORE RAILROAD COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $1,000,000. Those interested are Rudolph T. McCabe, William R. Heath, Gerritt H. Perkins, Eugene L. Bushe, Walter H. Pease, Edward J. Mathewson, William H. Shilmerdine, James R. Bach and Clarence S. Simpson.

THE FOSTORIA INCANDESCENT LAMP COMPANY has been incorporated at Fostoria, O., with a capital stock of $100,000. Mr. J. B. Crouse is president of the new company; Mr. R. Crocker, vice-president, and H. A. Tremaine, secretary and treasurer. A bonus of $10,000 has been given the Company by Fostoria to secure the institution, and work on the new buildings will begin about March 20. The capacity of the plant will be 2500 lamps per day and with a full force 200 men will be employed.

TELEGRAPH AND TELEPHONE.

HENDERSON, TENN.—A telephone line has been completed between this place and Tupelo, Miss., including several intermediate points.

VICKSBURG, MISS.—The City Council has granted a franchise to the People's Telephone Company, which will begin work on its system as soon as material can be secured. It is stated that the new company has an abundance of capital, and has already secured about 200 subscribers in this city.

KALAMAZOO, MICH.—The new Kalamazoo telephone exchange has passed into the hands of the new State Telephone Company of Detroit. Under the new arrangement, exchange subscribers will have connection with the long distance line. It is proposed to make the rate on county toll service 10 cents.

ASHTABULA, O.—The City Council has granted a twenty-five years' franchise to the People's Telephone Company, a local organization. The ordinance limits the charges to $24 for business houses, and $18 for residences. The new company will begin construction work at once and expects to have its exchange in operation within sixty days.

HARRISON, ARK.—The Harrison Telephone Exchange, of which Mr. C. D. Morris is manager, has recently established a toll line from Harrison to Eureka Springs, Ark., a distance of fifty miles. The Company uses nothing but the Standard Telephone Company's instruments. The Standard Telephone Company's headquarters are at Madison, Wis.

DELAWARE, O.—The Citizens' Telephone Company, of this place, will build lines in the Spring to Ostrander, Magnetic Springs and several other nearby towns. These will be connected with the independent system now in operation in Marysville and surrounding towns, and the service, it is stated, will be superior to that rendered by the Central Union Company.

ELECTRIC LIGHT AND POWER.

LOCKPORT, N. Y.—The common council voted a bill authorizing the city to bond itself for $50,000 to build a lighting plant.

PORT HURON, MICH.—There exists some sentiment in this city in favor of establishing a municipal electric light plant, but there is considerable opposition to the scheme on the ground that an increase of the public debt is inadvisable. A Port Huron paper is opposed to the idea, and thinks that the existing electric light company is entitled to some consideration to the end that its plant should not be rendered valueless by a rival plant owned and operated by the city.

GLADSTONE, MICH.—The City Council has decided to establish a municipal plant with a capacity of 40 arc and 1000 incandescent lights. In view of this decision the Gladstone Electric Light Company, whose plant was recently burned, will not rebuild.

STURGES, S. D.—At a meeting of the City Council of Sturges, the proposition made by A. D. Stewart, of this city, to put in an electric light and electric railway system was discussed and an ordinance granting the necessary franchise was framed and placed on its first reading.

NEW RICHMOND, WIS.—A thirty-year franchise has just been granted to F. W. Epley, General Manager of the New Richmond Electric Light & Power Company, privileging him to conduct into that city a power transmission line from Apple River, six miles distant. It is stated that sufficient patronage is already guaranteed to assure the success of the enterprise, and its projectors are now in the market for apparatus and supplies.

JACKSONVILLE, FLA.—The report of the city electric light plant for the year ending Dec. 31, 1896, has recently been presented to the Board of Public Works. The total cost of the plant to date has been $86,989.48. The cost to the city for operating the plant during the year was $30,858.78, and the receipts from commercial lighting were $27,802.71, leaving a deficit of $3,056.07. To this is added interest on $75,000 bonds at 5 per cent., which amounts to $3,750, making the total cost of lighting to the city $6,806.07. The city formerly paid, the report states, $8,000 each year for the lighting of its streets. The depreciation was placed at 3 per cent., and the benefits accruing to the city and the increased quantity and improved quality of light, the report states, overbalance many fold the item of depreciation. The plant includes two Babcock & Wilcox boilers, two Hamilton-Corliss engines of 400-hp each, two Brush arc machines of 125 2000-cp arc lamps each, and two monocyclic machines with a combined capacity of 6000 16-cp incandescent lamps.

The Electric Railway.

PITTSBURG, PA.—A rapid transit from Squirrel Hill direct to the city is expected to materialize soon.

RED BANK, N. J.—The building of a trolley line from Red Bank to Freehold by way of Holmdel is being agitated.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company has been granted a charter to extend its lines to Thomaston.

McDONALD, PA.—McDonald business men are agitating the building of an electric street car line connecting this place with Carnegie.

SHENANDOAH, PA.—The Panther Creek valley towns will shortly be connected by an extension of the Tamaqua & Lansford Electric Railway.

EASTON, MASS.—The Mansfield & Easton Street Railway Company has been formed with the intention of building a road from Mansfield to Easton.

RICHMOND, IND.—Information was given out at Richmond, Ind., regarding a new line of railway. It is to run from Richmond to College Corner, O.

McKEESPORT, PA.—A charter has been granted to the Charleroi, Bellevernon and Fayette City Railway Company. It will connect the three towns named.

NEW PALTZ, N. Y.—The New Paltz & Walkill Railroad Company has been granted a franchise for the construction of a trolley from Highland to New Paltz.

WILKESBARRE, PA.—The Wyoming Traction Company, as soon as the weather permits, will make extensive alterations on some of its lines, the most important of which will be on the Nanticoke branch.

BROOKLYN, N. Y.—Mr. R. K. Bryers has been appointed Superintendent of Trucks for the Brooklyn Heights Railroad Company, and Mr. William H. Blood has been appointed Superintendent of the Eastern Division of the same Company.

HARTFORD, CONN.—The petition for a charter for the Hartford & Torrington Tramway Company was heard and favorably decided upon. The proposed railway is intended to connect Torrington with Framington, and thus afford connection with Hartford.

WORCESTER, MASS.—The Aldermen of this city have passed an order asking the City Solicitor for his opinion as to whether the city may purchase the Consolidated Street Railway under the provision of its charter granted in 1861, or, if not, what legislation is necessary to enable the city to make such purchase.

Trade and Industrial Notes.

THE NEW YORK CARBON WORKS, 39 Cortlandt Street, New York, has bought the Johnson Signal Works plant at Rahway, paying therefor, it is stated, $45,000.

MR. F. P. JONES, president of the late F. P. Jones Company, Buffalo, N. Y., has started an electrical equipment, construction and supply business at 126 Franklin Street, that city. Mr. Jones has had a long and practical experience in the electrical trade, and no doubt will meet with success in his new venture.

OTTO GAS ENGINES.—The Otto Gas Engine Works, Philadelphia, in a catalogue now being distributed, gives a description of the several sizes of its marine engines, also some excellent illustrations and drawings of boats equipped with these machines. The features of the Otto engine are numerous, and render this make of machine eminently suited as a marine engine.

BRANCH OFFICE OPENED.—The Davis & Egan Machine Tool Company, Cincinnati, O., has just opened a branch office with the Cleveland Tool & Supply Company, at 5 Long Street, Cleveland, O.

MR. M. L. LIVINGSTON, of the Standard Thermometer & Electric Company, Peabody, Mass., manufacturers of the Upton Midget Arc Lamp has just returned from a business trip through New York State. He reports a large number of sales, and says that the Midget Lamp has established a sure foothold for itself in this part of the country.

THE ST. ANTHONY FALLS WATER-POWER PLANT.—It is expected that this plant, which was described in The Electrical World of Jan. 23, 1897, will be running by the latter part of August, this year. Mr. Edward P. Burch, engineer in charge of construction, and Mr. Charles G. Armstrong, of Chicago, the consulting engineer, are in charge of the installation, and in connection with Mr. A. M. Robertson, are placing the final contracts for the materials and supplies needed.

THE BALL & WOOD COMPANY, 120 Liberty Street, New York, is preparing to ship two of its 150-hp standard simple engines to the Portsmouth Street Railroad & Light Company, Portsmouth, O., these making the third and fourth Ball & Wood engines respectively used by this road, and a total of about 600 horse-power. Last week this Company shipped its second engine to the Lake Mohonk Mountain House, the well-known Summer resort on the mountains above New Paltz, N. Y.

THE EASTERN ELECTRICAL SUPPLY COMPANY.—This concern has recently been organized for the purpose of carrying on a general electrical supply business. Its headquarters are at 26 Cortlandt Street, New York. Messrs. B. H. Ellis and C. P. Scott are the promoters of the Company, and both gentlemen have been in the electrical business for the past ten years, and have had a great deal of practical experience. Mr. Ellis is president and manager of the Company, and Mr. Scott is vice-president and secretary. Both gentlemen are well-known, and no doubt will receive their share of the business.

GRAPHITE FOR RESISTANCE PURPOSES.—For some years the Joseph Dixon Crucible Company, Jersey City, N. J., has been supplying graphite resistance devices in quite a large way to telephone companies, electric light companies and electricians generally. The resistances have been so satisfactory and the demand so promising that the Company has added to that department of its works, dynamo and all necessary apparatus for testing purposes, and is prepared to furnish graphite resistances in round or square rods, tubes, spirals and other devices, of one ohm resistance or one million ohms resistance as required.

ELECTRIC PUMPING MACHINERY.—The General Electric Company has just issued a handsome catalogue of its pumping machinery. The advantages of the use of electric pumping machinery and the economy of the same are set forth, and the half-tone illustrations are of excellent quality and printed on very fine plate paper. Considerable information on hydraulics is also included in the catalogue, which will be found of value for quick reference. It is surprising in looking through the list to note the great variety of applications of electric pumps, and a perusal of the catalogue gives a good idea of the extent and importance of this branch of electrical industry.

THE HASCALL STEAM GENERATOR.—The practical value of the Hascall steam generator is evidenced in the case of Ferdinand Braun, 175-179 Hester Street, New York City, who had one of these generators installed on the boiler in his establishment. In a letter to the Hascall Steam Generator Company, 26 Cortlandt Street, New York, Mr. Braun states that he formerly found it difficult to keep steam at 70 lbs. with pea coal, but since the device was installed he has had no trouble in keeping the pressure up to 90 lbs. when desired, and that with buckwheat coal, using the same quantity as was formerly used of the pea size. The saving, he states, is about 20 per cent.

MODERN FOUNDRY BUILDING.—Theodore H. Colvin, Providence, R. I., has commenced work on his new foundry building. This building will be 102 feet wide and 180 feet long, and will be complete and modern in every respect. The central portion, 50 feet wide, will be served with a 20-ton traveling crane, and at distances of about 25 feet in the length of the building will be placed 5-ton jib cranes swinging from the central portion of the building over the moulding floors in the wings, which extend along both sides of the building and are 25 feet wide. The entire framework of this building will be steel. The roof covering is to be slate. The steel work is being furnished and erected by the Berlin Iron Bridge Company, East Berlin, Conn.

THE LA CAPITAL COMPANY, Buenos Ayres, Argentine Republic, South America, has let contract for the materials for a power station, the necessary equipment for the power in the station, and the roadbed and cars to parties in the United States. The Berlin Iron Bridge Company, East Berlin, Conn., has the contract for furnishing the skeleton steel-work of the building and the roofs. The roof over the engine and dynamo room will be covered with corrugated iron, lined with the Berlin Company's fireproof, anti-condensation roof lining. Taking into consideration the magnitude of the work and the distance it is to be shipped, it is to be considered a good recommendation for the Berlin Company's roofing.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has taken the agency of the Syracuse rail bond. This bond is said to be the only one on the market that utilizes the fish-plate holes and requires no drilling. It is soldered fast to the rail, and the fish-plate bolts reinforce the joints, making absolutely homogeneous contact during the life of the rail, and giving a surface connection between copper and rail of ten times the cross section of the bond conductors, thus making the best possible construction. The Syracuse bond is claimed to be the cheapest in first cost, cheapest to put on the rail, is economical, will save coal bills, and is indorsed unconditionally by the best engineers. The Metropolitan Electric Company has just issued circulars describing fully the rail bond.

"CAHALL" WATER TUBE BOILERS.—The Aultman & Taylor Machinery Company, Mansfield, O., has just issued the fourth edition of its book describing and illustrating its "Cahall" water-tube steam boilers. The book is strongly bound, and its contents are interesting and valuable to steam users in general. The construction of the "Cahall" boilers are minutely described and every part is illustrated in detail. Reports of several tests on these boilers are given, showing the generators to be highly efficient.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has always been careful to keep its customers posted on any changes in market prices, and to this end it publishes at frequent intervals a bulletin of prices on staple goods. Such a bulletin has just been issued. It contains valuable information to every purchaser of electrical supplies, and will be sent to any one in the trade on application. Besides covering standard goods it also includes a number of the Electric Appliance Company's well-known specialties.

A FINE CATALOGUE.—The Forest City Electric Company, Cleveland, O., manufacturer of roll drop and drop-forged commutator bars, has just issued a very neat catalogue describing and illustrating its products, and giving some interesting information concerning the same. Several letters are also reproduced to show that the Forest City Company's commutator bars are giving excellent satisfaction to all those who are using the same. The list of concerns using these bars is a long one. At the end of the book is given a table relating to divisions of commutators. The catalogue is printed in three colors and is very attractive in appearance.

THE CENTRAL ELECTRIC COMPANY, Chicago, advises us that the prospects for business are exceedingly promising. The inquiries for its numerous specialties are daily increasing, which is evidence that its customers are providing for a lively trade. The Wagner direct-connected alternating-current ceiling fan motor, for which it is general Western agent, is growing in favor. It has many and unusually advantageous features which seem to appeal to prospective users. The Central Company is bringing out a new form of spark arrester made entirely of Russia iron, and adapted to be used in connection with most any form of arc lamp. Circulars fully describing this are being sent out, and will be mailed on application.

SUCCESSORS TO T. J. MURPHY & CO.—The Eureka Tempered Copper Works, 511-513 West Thirteenth Street, New York, announce to the trade that they have succeeded to and will continue the business of the late firm of T. J. Murphy & Co. T. J. Murphy, H. M. Shaw, J. F. McGuire and N. Murray will manage the affairs of the new business, and the grade of work turned out in the past by the old firm of T. J. Murphy & Co. will be maintained by the new. Mr. H. M. Shaw's connection with this firm will not in any way conflict with his business at 126 Liberty Street. Mr. T. J. Murphy will continue to superintend the work and give his personal attention to all orders. N. Murray will be pleasantly remembered as Mrs. N. Murray, who was Mr. T. J. Murphy's office assistant during the existence of the late firm of T. J. Murphy & Co.

MR. JAMES G. BIDDLE, Drexel Building, Philadelphia, Pa., sole agent for Messrs. Willyoung & Co., has been very successful in securing a large number of orders for the now widely known "W-S" Rontgen ray apparatus. In addition to the adjustable condenser invented last year by Mr. Willyoung, a new improvement has been introduced in the "Ideal" automatic interrupter. It can be connected to any direct current up to 110 volts if regulated by a suitable rheostat, without the necessity for a rotary or mechanical break of any kind. A few of the recent orders received by Mr. Biddle are from the Episcopal Hospital, Philadelphia; Jefferson Hospital, Philadelphia; German Hospital, Philadelphia; Girls' High School, Philadelphia; Emergency Hospital, Washington; West Penn Hospital, Pittsburg; Williamsport Hospital, Williamsport, Pa.; Catholic University, Washington; Hospital, Alton, Ill.; Hospital, Boise City, Idaho; College of Medicine, Cincinnati; Hospital, New London, Conn.; Hospital, Lancaster, Pa., etc.

MR. C. H. CHALMERS, who has been for several years assistant manager and electrician of the D. & D. Electric Manufacturing Company, Minneapolis, Minn., has severed his connection with that concern and started in business for himself. Mr. Chalmers recently purchased the entire plant of the Claussen & Bonwell Electric Company, St. Paul, Minn., and has moved the same to Minneapolis, where it will be consolidated with that of the Electric Machinery Company. The new firm will do business at No. 32 Washington Avenue, South, under the name of the "Electric Machinery Company." Messrs. James G. Bonstead and C. H. Chalmers are the proprietors of the new concern. Both gentlemen are well-known in the Twin Cities and throughout the Northwest, and their many friends wish them abundant success in their new undertaking.

THE WASHBURN & MOEN MANUFACTURING COMPANY has just sold to the New York, New Haven & Hartford Railroad Company for its new electrical equipment at Berlin, Conn., a large number of its new "Crown" rail bonds. These bonds are to be stranded, are something more than 300,000 c. m. capacity and are to be applied under the rails, two bonds to each joint. Col. N. H. Heft, chief electrician of the railroad company, has had a large experience in such matters and thoroughly appreciates the merits of a good bond. The "Crown" bond has also just been sold for the equipment of the Lorain & Cleveland Railway and to the Brockton, Bridgewater & Taunton Street Railway Company. This bond is made in different shapes so as to meet all conditions of rail bonding, and is proving very attractive to street railway superintendents and managers.

P. & B. PAINTS.—New uses are constantly being found for the goods of the Standard Paint Company, 81 and 83 John Street, New York City, and the demand for the same in the Company's regular channels is on the steady increase. The Company states that it has never done so much business with electrical supply houses as at present. This indicates, in its opinion, a healthy condition of business, for the reason that when the supply houses order these goods in quantities for stock, there must be a good demand for them from central stations and electric railways. The Company does not alone make a specialty of the regular P. & B. insulating paints, armature varnish and tape, but manufactures a very high grade of preservative paint, roof coating, roofing, etc., which is guaranteed to be the best on the market. Good-sized samples of the Standard Paint Company's products will be sent free of charge to any one interested.

THE CARD ELECTRIC COMPANY.—It is reported that negotiations are now in progress with a view to moving to Toledo, O., the plant of the Card Electric Company, which is now located in Mansfield, O. The present plant is stated to be inadequate for the rapidly growing business of the Company, and in order to secure larger facilities for turning out its electrical machinery, the idea of moving it to Toledo was suggested. Mr. George F. Card was in Toledo a few days ago, and met a number of prominent business men of that city, and the matter was fully discussed. A committee was appointed to make detailed investigations. A further proposition was made to Mr. Card in the shape of a recapitalization project on a basis of $500,000. The Company asks no bonus; it simply desires to recapitalize and reorganize on a basis that will enable it to take advantage of the facilities for business that are almost daily proffered it.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 9, 1897.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

578,333. PIPE; H. B. Hilgeman, St. Louis, Mo. App. filed Dec. 10, 1896. As a new article of manufacture, a pipe having a glass lining and a layer of cement surrounding the glass.

578,333. THERMAL CIRCUIT CLOSER; H. S. Maxim, Norfolk, Virginia. App. filed May 29, 1896. In an electric signaling apparatus, the combination with signaling mechanism, and a relatively stationary contact connected with one terminal of an electric circuit, of two thermostats arranged in said circuit, one of which is adapted to close a circuit through the signaling mechanism either by contact with the other thermostat or by contact with the relatively stationary contact.

578,380. CALL RINGER FOR TELEPHONES; J. A. Williams and S. Abbott, Cleveland, O. App. filed April 10, 1896. In a ringer for telephones, a tripolar permanent magnet and an electromagnet fixed between the legs of the magnet whereby the lines of polarity in both of said magnets are on the same plane.

578,386. TELEGRAPHIC REGISTER; C. E. Beach, Binghamton, N. Y. App. filed Oct. 21, 1895. A magnet; a revoluble part containing projections capable of engaging with a latch; a latch operated by the magnet and controlling the motion of the revoluble part, and a slide or beam operated by the collision of the revoluble part and latch.

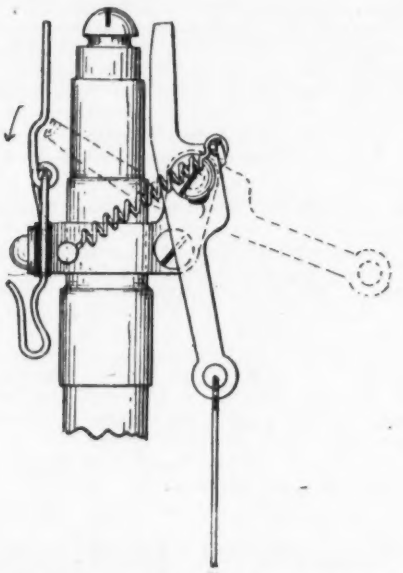
578,394. MANIPULATING DEVICE FOR INCANDESCENT LAMPS; J. J. Dunn and J. W. Regan, Boston, Mass. App. filed March 9, 1896. An incandescent lamp manipulating device consisting of a pair of pivoted expansion-jaws, pivoted to a case or shell, a flexible shaft or spring attached to said shell, a spring-pressed expander-rod arranged within the latter and links connecting said rod to the jaws and means for closing and adjusting the position of said jaws.

578,402. CAR ANNOUNCER; W. A. Heckard and D. Ogden, Columbus, Ind. App. filed May 14, 1896. The combination with a pair of open circuits each containing a pair of terminals, an electromagnet connected with each of said circuits, a lever pivoted near said terminals and adapted, when swung upon its pivot by the movement of a car, to bring one pair or the other of said terminals into engagement with each other and thereby energize said magnet, means for returning said lever to its normal position, an armature pivoted near said magnet and provided with a dog, the said armature being adapted to be operated upon by said magnet, an open circuit containing an electric signal, a pivoted arm adapted to close said circuit by engagement with a suitable terminal, said arm being adapted to be engaged by said dog and thereby held out of engagement with said terminal, and means for throwing said lever into engagement with said dog.

578,420. ELECTRIC GAS-LIGHTER; F. N. Pike, New York. App. filed March 11, 1896. An electric gas igniter consisting of a support for the terminals of an electric circuit, one of said terminals consisting of an arm pivotally mounted on said support and provided with a slot at its pivotal point, and a catch at one end adapted to engage and draw the other terminal to a point close to the point of emergence of the gas where engagement is broken, and means for automatically returning the pivoted arm to its normal position, through another path of movement so that it will not pass through the flame.

578,430. ELECTRIC METER; E. Thomson, Lynn, Mass. App. filed Aug. 26, 1889. The combination in an electric meter, of a rotating armature in a circuit of high resistance in derivation to the work and traversed by a current which is practically constant for all speeds of rotation while connected to a source of practically constant potental, a set of coils traversed by, or responding to the variable current fed to the consumption devices, said coils furnishing a whole or a part of the field in which said armature revolves, a retarding device moved by said armature consisting of a conductor movable in a magnetic field and consuming energy of rotation therein, and a registry device for counting the turns of the revolving armature.

578,442. DEVICE FOR OPERATING SIGNALS; S. S. Bogart, Schraalenburg, N. J. App. filed Feb. 7, 1895. In an electric signaling device, a rod carrying a signal at one end and attached near its other end to a properly-journaled shaft, carrying a pinion, in combination with a fulcrumed armature-lever provided at its free end with a rack meshing with the pinions on the shaft, and carrying a convex armature located between the fulcrum and the free end of the armature-lever, an electromagnet provided with a pole conforming in



No. 578,420.—Electric Gas-Lighter.

shape to the convex armature, and the counterbalance whereby the weight of the signal is adjusted to be raised by a magnet of little power, and is lowered by its own weight.

578,464. CONTACT FINGER FOR ELECTRIC CONTROLLERS; E. C. Parham, Johnstown, Pa. App. filed Nov. 18, 1896. In a contact finger for electric controllers, in combination, a magnetizable finger member, means for magnetizing said member and a contact carried by said member and carried between the poles thereof.

573,471. ELECTRICAL CANE; W. N. Sherman, Merced, Cal. App. filed April 2, 1896. A walking-stick having a chamber therein and a hollow handle combined with an electric battery, the parts of which are arranged within said chamber and nested metallic electrodes attached to the handle of the cane and forming a part thereof

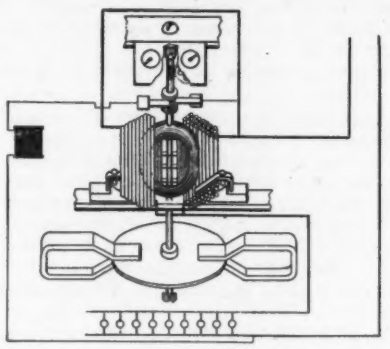
578,520. TELEPHONE TRANSMITTER; N. Lombard, Boston, Mass. App. filed June 24, 1896. In a telephone transmitter an apertured supporting-ring, an internal circumferential flange thereon, a diaphragm loosely resting upon said flange, a pin centrally of said diaphragm and a spring having its free end connected with the pin, the tension of said spring serving to normally maintain the diaphragm in a concavo-convex position.

578,539. TROLLEY SUPPORT; E. Blamey, Jersey City, N. J. App. filed Dec. 4, 1895. The combination with a trolley arm of a main frame or yoke connected therewith, the sides of which are directed upwardly, a supplemental frame or yoke pivotally connected with the upper end thereof, the sides of which are directed upwardly and a spring-supported frame or yoke mounted and free to slide therein, in the upper end of which is mounted a trolley wheel.

578,542. TROLLEY ROPE PROTECTOR; H. M. Brooks, New Haven, Conn. App. filed Aug. 26, 1896. The combination with the rope or cord of a trolley arm or pole of a shield or guard connected therewith adjacent to said trolley arm or pole, said shield or guard being cup-shaped in form and provided with a discharge-spout at one side mature, a frame in which the armature is mounted, circuit closers thereof.

578,611. ELECTRO-THERAPEUTIC SYRINGE; J. D. Rively, Pittsburg, Pa. App. filed April 24, 1896. In combination, a bulb, a flexible pipe leading therefrom, a second flexible pipe, a metallic sleeve between them carrying a binding-post, a casting in the end of the second pipe, a detachable nozzle thereon, a conduit leading therethrough, a socket in the end of the casting, and a wire extending through the second pipe into the socket and electrical connections.

578,643. ELECTRIC CUT-OUT; D. B. Kinch, Pittsburg, Pa. App. filed Sept. 26, 1896. In an electric cut-out the combination of the switch-piece or lever and the rotary plug for operating the same, said



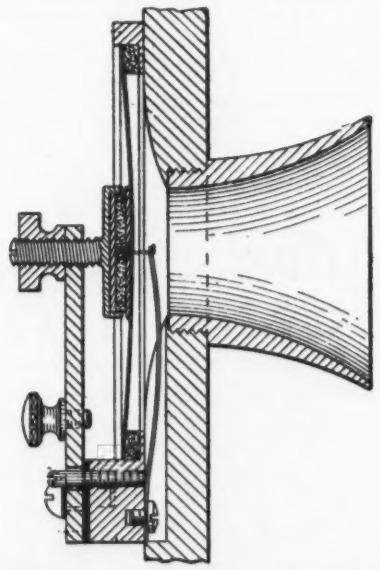
No. 578,430.—Electric Meter.

plug being adapted to a socket and freely removable and carrying the loop or branch wire to connect the same electrically in circuit.

578,655. CEILING CUT-OUT; H. T. Paiste, Philadelphia, Pa. App. filed May 8, 1895. The combination in a ceiling cut-out of the body portion having terminal plates thereon, one plate having a recess and the other a retainer, with a cap having terminals, one terminal having a tongue adapted to fit loosely in the recess in one of the plates of the body so as to form a loose hinge on which the cap can swing vertically, the other terminal being slotted so as to engage with the headed retainer.

578,670. TELEPHONE; J. Weigel, Boston, Mass. App. filed July 14, 1896. In a telephone the combination with an enclosing casing provided with a diaphragm, of a permanent magnet provided with a front pole-piece, a spring interposed between the said casing and the said magnet and acting on the latter in a direction to move the pole-piece away from the said diaphragm, and means to limit the movement of the pole-piece away from the diaphragm.

578,673. MAGNETIC APPARATUS; A. Boetcher, Philadelphia, Pa. App. filed May 31, 1895. The combination in a magnetic apparatus of two magnets, a third magnet being so arranged in advance of the other two magnets that the cores will overlap, a plain cylinder armature, a frame in which the armature is mounted, circuit closers operated by the armature whereby the armature will be attracted first by one magnet, and then when above the core of said magnet will be attracted by the other magnet so as to give the armature a



No. 578,520.—Telephone Transmitter.

long movement in one direction with means for returning the armature to its first position.

578,695. TURN BUTTON FOR ELECTRICAL SWITCHES; J. S. Gibbs, Hartford, Conn. App. filed Jan. 6, 1897. The combination with the spindle of an electric switch, of a turn button or key fitted to said spindle and adapted to rotate it, said button or key being so mounted to have a limited movement in the direction of the axis of said spindle, and a spring confined within said button or key and between suitable abutments to yieldingly press the button or key against the cover or face-plate of the switch.